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ALBRECHT VON HALLER: SCIENTIFIC, LITERARY, AND POETICAL ACTIVITY.

By JOHN C. HEMMETER, M. D., PH. D.

Albrecht von Haller was born October 18, 1708, at Bern, Switzerland. He was the fourth and youngest son of the attorney-at-law, Nicholas Emanuel von Haller. According to his own biography and the statements of his most reliable biographers, Ludwig Hirtzel and Jacob Baechtold,[1] he was possessed of extraordinary and precocious powers of observation, versatility in language, poetic talent, and unusual industry in collecting facts and objects. He is said to have been a very weakly, timid, and always serious child, and was taught by an old pedantic theologian, whose curious character aroused the satiric, poetic power of his tantalized pupil.

Haller himself narrates to his oldest biographer that at the age of nine years, he had produced an extensive lexicon of all the Hebrew and Greek words of the Old and New Testament, a Chaldaic grammar, and between one and two thousand biographies of distinguished personages.

However incredible these statements may appear, Ludwig Hirtzel, who, according to my friend, Professor Henry Wood of the Germanic Department of the Johns Hopkins University, is an absolutely reliable biographer, gives an authentic poem of Haller's of the year 1721, which is an elegy on the death of Frisching. The poem was written then when Haller was 13 years old, and in its title the poet calls himself a "poet who is a lover of virtue and disciple of wisdom." Whilst this poem does not show the perfect rhythm and majestic sentiment of the poems of his later years, it is nevertheless an effort that must be considered genuinely poetic.

In 1722 he left his native city and became a student under the physician John Neuhaus in Biel, who was a worshipper of the doctrines of Cartesius (Descartes), which, however, repelled his brilliant pupil.

At that time Haller was 14 years old, and now we are told of his first morbid inclination. He was continuously sick, avoided playmates, locked himself up for months and consoled himself with poetry in various languages. He wrote a long epic poem on the Origin of the Swiss Union of States, several tragedies, and translated Ovid, Horace, and Virgil. As another evidence of a morbid inclination, the facts may be cited that he once saved this mass of verse and literary compilation from a burning house at great risk, but later on he burnt them up, part and parcel.

In 1723 he went to the University of Tübingen, but was not well impressed with the rushing student life there, nor made much progress in his special studies, and in April, 1725, he

[1] Geschichte d. Deutschen Literatur in d. Schweiz, p. 489.

went to Holland to study under the renowned Boerhaave at the University of Leyden. A month before his departure, as Haller himself writes, he composed the beautiful hymn "Morning Thoughts." This is an apotheosis on the Omnipotence of the Creator and is undoubtedly one of the most impressive poems in the German language. A few lines to illustrate this poem may be pardoned:

Der Mond verbirget sich, der Nebel grauer Schleier
Deckt Luft und Erde nicht mehr zu;
Der Sterne Glanz erblaszt, der Sonne reges Feuer
Stört alle Wesen aus der Ruh—
Durchs rote Morgentor der heitern Sternenbühne
Naht das verklärte Licht der Welt;
Die falben Wolken glühn von blitzendem Rubine
Und brennend Gold bedeckt das Feld.

And then our poet, addressing the Creator of Nature, continues:

Du hast der Berge Stoff aus Thon und Staub gedrehet
Der Schachten Ërz aus Sand geschmelzt;
Du hast das Firmament an seinen Ort erhöhet,
Der Wolken Kleid darum gewälzt.

At that time Boerhaave was in the fullness of his power. The maturity of his broad experience undoubtedly laid the foundation of all the future works of Haller, but here Haller met two other men of scientific greatness; the younger Albinus, Frederick Bernard Albinus, a skillful and sagacious anatomist, who in 1745 became Professor of Anatomy; and also Ruysch, who was his teacher at 90 years of age. He took his degree of Doctor of Medicine in 1727 at Leyden on the basis of a thesis in which he exposed the error of Professor Coschwitz of Halle, who had maintained that he had discovered a new salivary duct of the submaxillary and sublingual glands, which Haller proved to be a vein. Thereafter he traveled extensively in England, visited Belgium and Paris in 1728, and studied mathematics in Basel with Bernouilli. In 1730 he returned to Bern and there practiced medicine and continued his researches in anatomy and physiology, spending his leisure hours in noting down poetic inspirations and making botanical explorations. In 1736 his fame had spread to such an extent that George II of England, who was also Elector of Hanover and Braunschweig, offered him a chair of anatomy, botany, and medicine at the newly-founded University of Göttingen. Haller accepted, and labored in Göttingen for 17 years, carrying out his most important inquiries and compiling most of his literary work. He founded the anatomical museum and laboratory, the botanical school and garden, and the obstetrical department at Göttingen. He was one of the founders of the scientific association and editor of its commentaries. Later on, he refused several calls to other universities, noteworthy among which was one by Frederick the Great, to a chair at the University of Berlin.

He returned to Bern in 1753, prompted partly by illness and partly by ambition for official station in his Fatherland. In Switzerland he passed the last 24 years of his life, taking his share of municipal and state duties. He eventually was elected a member of the great National Council of Switzerland.

Towards the last years of his life, persistent severe pain led him to the continuous use of opium. He passed quietly away on December 12, 1777. In the last moments of his life he had his fingers on his own pulse and said to his friend, who was standing at his bedside, "The artery no longer beats."

Haller was married three times. His most extraordinary versatility as a poet, litterateur, political economist, botanist, physiologist, physician and surgeon, has been the wonder of his many biographers.

He applied his tremendous intellect to the solution of many questions throughout physiology, and in the preface of the sixth volume of his Elementa, he gives a list of what he claims as some of his own discoveries. There is no doubt whatever that he correctly recognized the mechanism of respiration, and his researches on the "formation of bone" and the "development of the embryo" are of the highest importance.

His Literary and Poetical Activity.

In the year 1728, Haller, in company with a friend, traveled through his native country, which up to that time had been to him an unknown territory. The real object of this trip was not so much to observe the works of man as to get into communion with Mother Nature. In accordance with this plan he made a collection of rare specimens of the Swiss flora, and in fact everything, whether of high or low degree, became the object of his undivided admiration. Never did the uplifting thought leave him that God indeed had made everything beautiful, and devoted to some purpose in nature's economy. The glacier and the gentian, the tumbling brook and the dew drop, one and all, united our enthusiastic teleologist to God's service in His boundless temple of Nature.

The impressions made upon him were put into poetic form in the following year in a poem entitled "Die Alpen" (The Alps). Haller compared with biting sarcasm the low morality of his native town, Bern, with that of the old Swiss type, and thus emphasized his sympathy with Muralt's staid reformatory tendencies, revealed in the latter's "Letters about Englishmen, Frenchmen, and about my Journeys." He advises sufferers from the low morality of large cities not to seek recovery by going to Paris, but by travel to Switzerland where liberty and sincere morality prevail. Haller, the sentimental precursor of Rousseau, calls the people of Switzerland happy because of their ignorance about those evils which are the usual concomitants of growing cities. In his poem, in which he gives evidence of all that manly strength of which he is capable, and in which moreover he displays intense longing for pastoral quietude, he described the inhabitants of the Alps, not as peaceful Arcadian shepherds of the well-known stage type but as children of Nature, honest, unsophisticated people of the good old time. He praises their high ideals of matrimony, their harmless, good-natured festivities, their brawn, their various occupations as called for by the changing seasons, and brings all these things to the notice of the dwellers in cities. He pictures to us a beautiful landscape, surrounded by the Alps, which serve as a natural defence

against the evil influence of the outer world. Winter approaches and you enter the hut high up in the mountains. Three generations gather around the fire-place—a young poet of nature sings his simple melodies, three older members follow him in turn, one speaking of the wonders of nature, and the others relating stories of heroism in the battles for independence, and praises:

Tell who removed with intrepid courage the yoke which is still borne by half of Europe.

Thus from the Swiss mountains resounds first the battle cry "In tyrannos," which Schiller, Haller's successor in many respects, so frequently used, Goethe having previously made use of a democratic motto from Haller for his "Goetz von Berlichingen." Liberty and decent moderation are the unflinching precepts in a poem which forms the sentimental and purposeful supplement to his "Vitiated Morals," and the satire "The Man after the World." The young citizen of Bern thus described his countrymen:

No, surely 'twas not so before France got to know us,
Unknown to us were then the very names of crime;
Harmful extravagance our poverty withheld.
Sin in its wake was foiled by gentle singleness.
We had one fatherland, one God, and one free heart;
But now, alas — we fall!
The courage of our citizens which sanctified a state
The marrow of our fatherland grows old and dies away,
And once again in history the world will surely read:
How states must go to ruin when moral law they will not heed.

Later on he renounced his praise of these Alpine children of nature, for it subsequently became evident that the youthful traveler had transported himself in his poetic fervor to a beautifully conceived past, or to a place that existed merely in his fancy when he said that the shepherds prefer the sparkling water from the mountain spring to the golden wine, or the son of nature despises the gold sand in his rivers: "The shepherd sees this treasure, he merely looks at it and lets it float away." This sentimental bias and pessimistic view of civilized life was supplemented, however, by a very practical common sense view of nature on the one hand, and on the other by an exuberant optimism of a religious character. Haller believed, like Leibnitz and Pope, "Everything which exists is good and for the benefit of humanity." Thus the Alps furnish us in their vegetation with medicinal herbs, the mountains with crystals and curative springs, and the icy glaciers even are there for a purpose, in that they irrigate the surrounding country. In brief, the Creator has done everything for the best of humanity. But such doctrine made it incumbent upon him as a faithful follower of Leibnitz to work out a so-called theodicy, an explanation of God's indulgence in permitting the existence of evil at all. He good naturedly pacifies us with the assurance that God's divine kindness will work out everything for the best, whereby humanity, "the pitiable, intermediate type between angel and beast," does not become the wiser.

During the first half of the eighteenth century one fanciful theodicy followed another. The fearful earthquake of Lisbon in 1755 gave the optimists a severe blow. Voltaire, Haller's opponent, in a poem devoted to this awful catastrophe, referred to the latter as a terrible argument against the above-stated doctrine. Voltaire himself, had deduced the existence of God from the established order of creation, without resorting to such ridiculously trivial teleology as to praise the creator of the cork-tree as the furnisher of the highly useful stopper. His often quoted saying, "If there were no God he would have to be invented, but all creation proclaims his existence," should be treated with as much consideration as Haller's maxim—"Enough! There is a God, for nature doth proclaim it." But now the best sections of a flourishing city go to ruin, and in the deliciously satirical tale, "Candide," this pious hallucination is mercilessly scourged. Haller, who took pleasure in displaying his antagonism to Voltaire, had by that time already given up his poetic activity. One small volume of poems represents about the extent of it. It is this feature, in conjunction with an unusual intensity of thought, which gave to his "Swiss Poems" an epoch-making value. By way of contrast to a whole cluster of poetasters of the "quantity not quality" variety, a serious philosophic poet had made his appearance. These made rhymes after rhymes in quick succession; but he, conscientious about the wording of his verses and the creation of new forms wherever he felt the need of such, was content to complete about ten verses an evening. The former showered fulsome, insipid eulogies on their friends and patrons, but he pointed out the line of demarcation which separated his Nuptial Song to a Swiss Cato[3] from the usual cheap congratulatory poems. On the one side chaff, on the other side grain, although of a small quantity; on the one side dazzling raiment, on the other a heavy suit of armor; there prodigality, here economy, almost penury; there superficial amusement, here high ideals pertaining to life and its problems.

Haller was the first to impart force and depth to German poetry, even if he did not assist in bringing about facility of expression. One should read his truly great fragment "About Eternity," in which he portrays a desolate landscape, crags, sinister trees, a bird that has lost its way, and an idly-flowing brook—a spot where the lonely pilgrim directs his attention to the contemplation of eternity and is overwhelmed by the thought of a beginning without an end. But how can he, who is subject to finite conditions, comprehend the infinite:

On awful numbers I place numbers,
And millions of mountains I heap;
I roll cycles upon cycles and worlds upon worlds;
And when from this tremendous height
With trembling fervor I again thee seek,
O God! All might of numbers
Increased a thousandfold
Is not yet a part of Thee!

Kant cites these lines of "the most sublime German poet" in his essay on the "Infinite in Creation." To regard life from

[3] Note by J. C. H.—M. Porcius Cato, the elder, was noted as a rigid judge of morals, and this Swiss Cato must have been of the same character.

a pleasant point of view, to sing the songs of youthful gaiety, was foreign to Haller's ponderous nature. Inclined to loneliness, reserved and sensitive, lacking resiliency to experiences of a disagreeable character he kept aloof as he himself stated from a real understanding of the joy of youth. Love was to him the most serious occupation to which he devoted himself. Although penurious in his lyric effusions relating to it, he however created in his "Doris" the ideal of womanhood; his deeply-conceived elegies on the occasion of the death of his first wife and also on that of his second were evidences of his intense feeling. With this tearful offering Haller bid the world of poetry farewell.

As a Göttingen professor, soon afterwards Albrecht von Haller became famous throughout Europe as the "Great Haller." The Academy of Berlin sought him, but the free-thinking tendencies of Frederick's court were distasteful to the pious Christian. Possessed of immense learning, he devoted himself with indefatigable industry to scientific study. Histories of botany, physiology, and anatomy must each give him his due share of honor. An examination of the mural decorations of the exterior of the University of Vienna reveals his name as combining in one person the rarest abilities of the investigator and experimenter in the domain of natural science with an almost unattainable knowledge of litterature, and withal pervaded by an unusual sense of modesty. He was a veritable encyclopedia of information, "πολυμαθής," wrote for many years reviews on books relating to all departments of knowledge, at one time appeared in the rôle of a theologian, at another as a politician, and in his last period became a statesman and administrator of public affairs. He rehabilitated the poetic and scientific fame of Switzerland. The very fact that a scholar of his type should not disdain to write a volume of poems, exalted poetry and the poet in the estimation of the people.

Contributions to Anatomy and Surgery.

Albrecht von Haller must be mentioned as one of the first to investigate the etiology of septicæmia. He made the experiment of injecting putrescent substances into the veins of living animals, establishing the fact that they were rapidly killed thereby.[3]

In another direction he stimulated pure surgical research—namely, in an investigation concerning the development of a collateral circulation after the ligation of larger vessels—the larger anastomoses had in fact been made out by Haller.[4] Concerning echinococcus of the liver, Haller held the view that it was an exuberant formation of follicles.[5]

The founder of the surgery of the diseased states of the biliary passages was J. L. Petit, who recommended puncture of the gall-bladder for advanced stagnation of bile, and the removal of gall-stones by incision; but to make both operations feasible, he postulated the necessity of adhesion of gall-bladder with the abdominal wall. The first to support the views of Petit were Haller and Morgagni.[6]

Haller described exactly the invagination of the colon into the rectum and gave its differential diagnosis from rectal prolapse.[7] In writing the history of hernia as a pathological entity, it should never be forgotten that Haller clearly described the peritoneal process extending into the scrotum as the persistence of a fœtal physiological formation; opposing the view of Reneaulme, then prevalent (since 1721) that it was an abnormal place for peritoneum, for he and J. Hunter demonstrated the protrusion of the peritoneum that preceded the descent of the testicle, and argued that in congenital scrotal hernia the intestinal loops must of necessity follow the same channel. Haller correctly described a large hydronephrosis discovered by him at autopsy.[8]

His principal achievements in anatomy were: 1, a demonstration that the salivary duct discovered in 1724 by Coschwitz, was a vein; 2, an investigation of the respiratory muscles and an exhaustive description of the diaphragm, with an interpretation of the intercostal muscles as elevators of the ribs; 3, a demonstration of the uterine musculature; 4, a demonstration of the coni vasculosi, Vasculum aberrans Halleri; 5, a correct description of the musculature of the heart and an accurate description of the pericardium and of the valves in the veins; 6, a description of a number of unknown or, at least imperfectly known arteries (Tripus Halleri, triple branching of the cœliac artery, description of the course of the musculophrenic and of the internal mammary artery, anastomoses of the internal mammary with the intercostal artery); 7, the higher location above the pubes of the bladder in children; 8, a description of the omentum; 9, a demonstration of the Tela cellulosa as a connective tissue substance.

His successors in Göttingen were Johann George Roederer, 1726 to 1763; Johann Gottfried Zinn, 1727 to 1759, and Heinrich August Wrisberg. Zinn and Wrisberg, two undoubtedly brilliant anatomists, were direct pupils of Haller. Zinn has become immortal through his classical description of the eye and its surrounding Zonula of Zinn (ligament of Zinn). This illustrious pupil of Haller became professor of medicine and director of the botanical gardens in Göttingen, 1753 to 1759.

The Swiss clinician, John George Zimmermann, was also a pupil of Haller. Both Zinn and Zimmermann assisted him in his investigations concerning the brain. Among the successors at Göttingen was Samuel Thomas Soemmering, 1755 to 1830, whose comprehensive text-book is a monument in the history of German anatomy. Soemmering was undoubtedly the most talented German anatomist at the beginning of the nineteenth century. Among the other intellectual descendants of Haller are Johann Friedrich Blumenbach, the founder of modern anthropology, and Johann Friedrich Meckel. Thus

[3] Friedrich Helfreich. Geschichte d. Chirurgie. In Neuburger's and Pagel's Handbuch d. Gesch. d. Med., iii, 20.

[4] Loc. cit., p. 86.

[5] Loc. cit., p. 219.

[6] Loc. cit., p. 222.

[7] Loc. cit., p. 239.

[8] Loc. cit., p. 276.

Haller's influence extended to the entire anatomical world of his period.

Concerning the functions of the Eustachian tubes, however, he did not recognize the full truth, for he believed them to serve the conduction of sound and not as Schellhammer experimentally proved in 1716 for ventilation of the tympanum.

Exact medical historic research must credit Haller with a valuable discovery concerning the anatomy of the eye, for he was the first to describe the "lamina cribrosa" at the entrance of the optic nerve into the eye-ball (see Comment in Boerhaavii prælectis Götting. 1749), and he also, as well as Zinn, made clear the structure of the choroideal tract in the eye,[9] but he again failed to grasp the actual fact when he denied the existence of muscle fibers in the ciliary body and that they could influence the size of the pupil. But in this error he had investigators no less noted than Morgagni, Zinn, and Fontana as companions. Whilst he paved the way for a correct physiology of vision by his doctrine of the irritability of nerves, he seems to have failed in grasping what was known of refraction. As I understand Haller (Elementa Physiologica, Lib. XVI) he regarded light as a form of matter and ascribed to it a remarkable degree of substantiality.[10] Although he attributed refraction erroneously to contraction and dilatation of the pupil, his conception of the projection of the visible object on the retina was correct. It was a valuable service to the physiology of vision to emphasize the retina as the organ for light perception and not the choroid as Marriotte had argued previously.

Haller's analytical thinking and patient observation gave much new information in regard to neurological and mental diseases that eventually led to searching inquiries. In his Elementa Physiologica[11] he not only compiled that which was of interest up to that date, but added his own rich experiences and observations at autopsies. He emphasized that the brain was abnormal in all diseases of the mind and that the pathological alterations frequently extended to the cord and nerves, and he asserted that if nothing abnormal could be detected in these parts in rare cases, it should not be concluded that they were normal, but he preferred to think that the disease process was located in the "finest organizations" of these parts or that perhaps the examination had not been exact or careful.

The history of the development of gynecology would not be complete without including his anatomical, physiological, and pathological contributions, which are embodied in part of the 28th book of the Elementa Physiologica.[12]

CONTRIBUTION TO THE PHYSIOLOGY OF CIRCULATION AND RESPIRATION.

One of the most definite facts of this greatest of modern medical encyclopedists, and a fact upon which all later anatomists and physiologists agree, is that by his exhaustive work in anatomy and physiology references to literary sources earlier than his time have not only been greatly facilitated but in great part have been made superfluous; *i. e.*, one need as a rule only refer to his writings to learn the views of his predecessors on any important fact in these subjects.

In his preface to his Elementa he opposes the separation of anatomy and physiology—for him they were inseparable and yet he himself was the first to make physiology independent by his objective way of thinking and the significance he gave to experiments on the living animal. Sir Michael Foster correctly says:[13] "When we turn from any writers of physiology preceding his time and open the pages of Haller's 'Elementa,' we feel that we have passed into modern times."

Microscopic work with higher powers was quite unknown to Haller, but all that could be observed by anatomical investigation simply,—even general histology,—whatever could be elicited by simple vivisection with the application of the means of stimulation known in those days—all that could be accomplished by these means are described in his Elementa in words that even to-day retain their full meaning; his facts are critically weighed and he cites the complete literature known to him.

The finer anatomical and physiological techniques of to-day were not dreamt of by him, and those processes of living matter that could only be studied by the methods and in the light of the chemistry and physics of those days were necessarily incorrectly or incompletely understood. In a study of the dynamics of the circulation whose foundation was laid by Harvey, Bellini, and Bovelli, or even earlier by Michael Servetus, Matheus Realdus, Columbus, and Cesalpinus,[14] the work and views of Haller are noteworthy. He was the contemporary of the versatile English divine Stephen Hales (1677 to 1761) a man whose mind was replete with original thought. His work on the physiology of plants and on hygiene is exceptionally meritorious, and in his work on "Hemostatics"[15] Hales describes his classical experiment of determining the hydrostatic pressure of the blood by tying a long straight glass tube into the artery of a horse. Singularly enough Haller, though familiar with this pioneer contribution, does not appear to estimate it sufficiently or correctly; in fact he does not cite Hales in his discussion of arterial pressure, although he makes use of his observations in his consideration of means "to determine the force of the ventricular systole," which perhaps was permissible in those days, for soon after more direct methods became available for this study.

Haller discusses exhaustively the determination of circulation time. He denies the so-called self-regulating mechanism of the heart, the coronary circulation, and even disproves it. This controversy arose again in the nineteenth century between Hyrtl and Brücke.

[9] C. Horstmann. Geschichte d. Augenheilkunde, pp. 496 and 497.
[10] Vide supra, p. 499.
[11] Lib. XVII, Sect. I, par. 17, Tom. V, Lausanne, 1763.
[12] Bernae, 1765; Muliebria: Sectio II, Uteri fabrica.
[13] Lectures on the History of Physiology, p. 207.
[14] Hemmeter. Johns Hopkins Hospital Bulletin, 1905, XVI, 165.
[15] Statical Essays, Vol. II, 1732.

In his description of the changes of the form of the heart during contraction and the cardiac impulse, he lays more emphasis on the changes of form than did Harvey. He shows familiarity with the influence of gravity and of the respiratory aspiration of the thorax on the circulation in the veins.

One of his most brilliant experiments as well as arguments is the demonstration of the automatism of the heart. Anatomists, physiologists, naturalists, and medical men in general at the time of Haller were under the ban of the doctrines of George Ernst Stahl (1660-1734), a brilliant metaphysical philosopher, and unfortunately for science of his day, an influential writer and man of exceptional individual force. He assumed that all physical and chemical processes in the living creature, even the very simplest, were fundamentally different from those in the lifeless world, in that they were induced and controlled by a "sensitive soul," the "Anima Sensitiva." This conception is entirely different from that of the "reasonable soul" of Descartes, by which this philosopher meant to differentiate man from animals. Stahl's "Anima" reminds one more of the "φυσίς" of Hippocrates, or the "Archæus" of Paracelsus and of van Helmont, for it is present in all that is living and disappears from it when death occurs. Stahl was the first "Vitalist" and his "Anima" was inseparable from the central nervous system. It is evident from this definition that an organ that could function when entirely separated from brain and cord was unthinkable to the medical world of Haller's day, when the doctrines of Stahl exerted a kind of tyranny over the opinions of physiologists. Now when the Bernese Aristotle with his then unassailable objective demonstrations and the force of his logic correctly proved the entire independence of the activity of the heart from the central nervous system—not only this, but even more, for he emphasized the irritability of the myocardium itself as the cause of the cardiac rhythmic activity,[16]—he dealt a killing blow from which the hypothesis of Stahl could not recover.

As said before, Haller must be credited with the first correct and complete presentation of the mechanism of respiration, for there were other prominent anatomists, Hamberger (1697-1755) for one, who held that the lung contracted by its own inherent power, like a muscle, and that the pleural space between the lung and thoracic wall contained air. Haller succeeded in preparing the costal pleura in a living animal without injuring it in the least, so that the lung could be seen through it. He showed that the lung passively expanded, whilst it followed the receding thorax and descending diaphragm. His description of the diaphragm is anatomically perfect.[17]

It is regrettable that the chemistry of respiration was a "terra incognita" to him, who like many other thinkers of his time was held perplexed in the dark maze of Stahl's phlogiston theory. He knew of John Mayo's work on Respiration, and even cites it, but he failed to understand what Mayo meant by his "Nitro-Aereal" or "Igneo-Aereal" particles. The appreciative mind of to-day reading Mayo's ideas in the light of later progress by van Helmont, Lavoisier, etc., can understand that Mayo meant that the part of the atmosphere that was essential for burning was essential for all the chemical changes on which life depends and that the "Nitro-Aereal" particles of air are the oxygen of to-day. It is questionable whether any of Haller's contemporaries understood Mayo, or even whether this English apostle of physiology was understood in his own country. I do not think it correct to assert, as Sir Michael Foster does,[18] that Haller rejected the advances of the English school (Boyle, Hook, Lower, and Mayo). He gave them fair consideration; he did not accept them; neither did he clearly reject them. He was an agnostic for the time, as most conservative thinkers should be. One must not overlook the fact that these men expressed themselves largely in terms of their own invention concerning their views of respiratory gases, and that they were unavoidably vague, and were not in entire agreement. After discussing all views known to him, Haller declines to accept the view that particles of air actually pass into the blood; but immediately thereafter warns the reader that his doubt concerning the theories of the English school "does not or should not lead to the conclusion that in breathing we derive nothing from the air."

Haller induced his disciple Rhodes[19] to write a dissertation on the iron content of the blood (Göttingen, 1753) and he attributed the red color of the blood to the iron.

The physiology of the larynx is excellently presented in his Elementa,[20] but he appears not to have known the function of the lateral cricoarytenoid mucles in opening the glottis.

Contribution to the Physiology of Digestion.

To the modern student of Haller's physiology it soon becomes apparent that the weakest points of Haller's work are where he comes in contact with purely chemical phenomena in the explanations of the processes of life, and this is not surprising, since the chemistry of today was practically unknown. It was not until after Haller's death that Scheele, contemporaneously with Priestley, discovered oxygen in 1786. I have already referred to the retarding effect of Stahl's phlogiston hypothesis, which impeded the development of chemistry fully as much as the delusion that the septum of the heart is perforated did retard the development of the physiology of the circulation of the blood.[21] Even Scheele was an ardent adherent of the phlogiston theory. It is quite pardonable, therefore, that Haller, who had no special training in chemistry and had not even been an apothecary, like some of the clinicians and chemists of his time, should have no comprehensive knowledge of the chemical progress taking place during his life and which was giving birth to a new

[16] Elementa, Vol. I, p. 488.

[17] De diaphragmate. Göttingen, 1791.

[18] Loc. cit., 230.

[19] Borettan, Gesch. d. Physiol. (Julius Pagel writes this name Rhades) in Part I of Neuburger's and Pagel's Gesch. d. Med.

[20] Vol. III, p. 366.

[21] Hemmeter. Johns Hopkins Hospital Bulletin, 1905, XVI, 165.

chemistry under the stimulus of Black, Mayo, and Priestley in England and Lavoisier in France.

This same defect in interpretation we find in Haller's presentation of the functions of the digestive organs, where we find many erroneous conceptions; but his description of digestion is distinctly in advance of the time. The activity of the salivary glands as dependent upon nerve influence (irritation by smell or taste) is an idea that does not appeal to him, although he concedes a certain degree of irritability to the salivary glands. To him the saliva is neither alkaline nor acid, and he interprets its function to be merely a mechanical one to aid in the formation of the bolus and facilitate swallowing. He does not know its starch-digesting property, for ptyalin was not discovered until 1831 by Leuchs.

The glands of the stomach furnish only mucus according to Haller. The gastric juice is a kind of transudate from the arteries; it is neither alkaline nor acid, but neutral. Acid is not present in the stomach normally; if present at all it is derived from abnormal decompositions of the gastric contents. In the sixth volume of his Elementa, page 57, he looks with disfavor on the use of the word "ferment," to explain the action of the gastric juice, which is, according to him, much assisted by the grinding and mechanical effects of the movements of the stomach.

The various functions of the pancreas are not known to him. Though he speaks of neutralization (Milderung) as being one of them, he does not mean neutralization of the gastric juice but of the bile.

The bile he considers to be an especially effective secretion for digesting the fats, which he declares are immediately emulsified by it. It is according to him not an excretion but a secretion and this he attempts to demonstrate by the effects of excluding bile from the intestinal canal. It was still thought by many physiologists that bile was produced in the gall-bladder, but he was an opponent of this belief, as he knew that bile is produced in animals who have no gall-bladder. In this connection he emphasized the importance of comparative physiology. In connection with his doctrines concerning digestion, his discussion of the foods and diet of human beings are very interesting, but naturally imperfect in the light of our present knowledge.[20]

His description of the structure and the gross functions of the kidneys is admirable, but the chapter on the urine (this being again a chemical subject) is in accordance with the deficient knowledge of those days.

CONTRIBUTIONS, VIEWS, AND EXPERIMENTS CONCERNING THE CENTRAL NERVOUS SYSTEM.

Haller's work on the brain and spinal cord will be better understood after his doctrine of irritability has been studied. In testing the irritability of the brain and its membranes he frequently went too far, because of the incompleteness of his methods and crudeness of his instruments. A part of his first brain studies were upon the cerebral pulsations. In 1750 the Dutch physician Schlichting had shown that the pulsatory movements of the brain were caused by the activity of the heart and the respiratory movements, but at the same time had been led to assume a kind of independent brain movement. The question was taken up by the Paris professor Lorry, 1725-1786, who disproved the theory of an independent movement of the brain, but at the same time held that the brain pulsations were pathological. Haller[21] attributed the brain pulsations to venous stagnation. In his experiments on the gray cortex of the brain, he was assisted by his pupils Zinn and Zimmermann. The physiological techniques of these experiments were very faulty viewed from our present standpoint. They made use of needles and sticks of wood saturated in acid, which were stuck into the gray matter. It is not surprising that they always obtained the same results, namely collapse of the animals, and convulsions—the well-known epileptic attacks when the cortex is stimulated too powerfully. He considered the gray cortex as devoid of sensibility and attributes positive sensibility only to the white medullary substance. Thus he is opposed to ideas of localization, the beginnings of which had already been made by other physiologists. He recognized that the cerebellum, by carefully conducted experiments, could not be proven to be an organ that is essential to life,—that is, not more so than the cerebrum; but he conceded the great importance of the medulla as a portion of the brain that was immediately essential to life. This concession was, however, forced from him by his brilliant pupil Zinn. Lorry had shown that the only locality in the whole central nervous system through which convulsions could be caused invariably—that is of course after clean and careful experimentation—was situated in the medulla oblongata. Isolated injury of this spot could cause death, according to Lorry, and Haller recognized this also. Another epoch-making discovery he confirmed without reservation: the discovery of the contralateral innervation, by the French physician, Pourfour du Petit (1664-1741). This brilliant observer accurately described the crossed paralysis which occurred in trephined animals whose cortex had been injured on one side, and then demonstrated the decussation of the pyramids. There had been some intimation that such a crossing of the motor fibers probably existed, for the ancients had already described autopsy findings in persons who had died of apoplexy which foreshadowed the great physiological discovery of Pourfour du Petit.

THE NEW CONCEPTION OF IRRITABILITY AS FIRST PRESENTED BY HALLER.

In presenting this new aspect of living matter as first conceived by Haller it will be necessary to review the opinions helds on this same subject by physiologists prior to him. Sir Michael Foster says "And to call attention to the general view of Glisson's because this was the mother idea which led him to a special conception of the properties of muscular tissue, through which he anticipated modern teaching by nearly

[20] Elementa, Vol. VI, pp. 188, 258.

[21] Elementa, Vol. IV.

a hundred years. In his work on the liver, in discussing how it comes about that the bile is discharged into the intestines at certain times only, namely, when it is wanted, he shows that the gall-bladder and biliary duct bring about a greater excretion when they are "irritated." And he argues that they cannot be irritated unless they possess the power of being irritated. This power of being irritated he proposes to denote by the term *irritability*. And he develops this view again in his work on the Stomach (De Ventriculo), published the year of his death, though wholly written as early as 1662, but laid aside in order that he might devote himself to his work "*De Natura.*"

"Thus it is undoubtedly to Glisson that we owe the first introduction not only of the word but of the idea of irritability, which, revived by Haller, as we shall immediately see, in the next century became firmly established in physiology and has played an important part in the development both of physiological and pathological views. Haller used the word in its narrower sense as the property through which muscle responds by movement to an external stimulus; since then it has been extended to mean response in any way, not by movement or change of form only but by kind of change, chemical change, change of growth, and the like. And it is worthy of note that Glisson from the very first used the word in its widest sense, distinguishing the various ways in which irritability may be manifested and the various agents by which it may be called forth."

It was perhaps by reason of the fundamental and highly philosophical character of Glisson's conception that it did not meet with immediate recognition. The idea had to be put forth in the narrower form, which Haller gave it, in order to be understood by physiologists; but to continue to use a comparison of Sir Michael Foster's: "Glisson's irritability and his notable experiment were like Mayo's igneo-aereal spirit forgotten as the seventeenth century passed into the eighteenth. We have to wait until the latter century, when the truth was brought to light again by the sagacious Haller in his views of nervous action and its relation to muscular contraction."

From this narrative it is evident how the merits of an older investigator may be overlooked in the future development of a new discovery. Glisson was undoubtedly correct in the broader conception and application of the term irritability. Haller's inseparable connection with this discovery is, however, justified through the large number of objective demonstrations and experiments by which he succeeded in proving this new quality of living matter. To us of the twentieth century it might occasionally seem as if irritability had from time immemorial been one of the primordial conceptions of natural philosophers; and yet this property which at the present day appears as one of the most natural attributes of living matter was not even dreamt of before the days of Glisson nor understood before the days of Haller. The introduction of the idea into physiology constituted as great an innovation and brought about as many reforms and advances in physiology as did the conception and development of the new physical chemistry of our present day.

The most correct course to pursue in speaking of Haller's views concerning irritability will be to quote his own words in his Elementa: "There is widely present not only in the animal, but also in the vegetable kingdom, a contractile force by which the elements are brought nearer to each other. This not only seems to be the cause of cohesion in general, but is rendered manifest by the fact that a fiber drawn out lengthways when let go very soon returns to its previous length." This is more properly the elastic force. Besides this there is a contractile force by which the tissues dead or alive shrink when treated in various ways, when for instance they are heated. A contractile force of such a kind is present in almost all animal tissue, unless it be very soft and pulpy ones like brain, or very hard ones like bones and teeth. But there is in addition a special contractile force proper to muscles alone. "In a living animal or one only just dead there very frequently appears spontaneously in muscular tissue a swift contractile movement by which the ends of the muscle are alternately brought nearer to the middle belly and then again recede from it. And even when this contractile movement does not spontaneously appear, it may be excited if a stimulus, such as pricking, or pinching, or some chemical substance is applied."

"Many writers consider this living contractile force as identical with the dead one just described as belonging more or less to all tissues." This view Haller discusses and concludes, "That muscular fiber is the only one which is moved spontaneously in the living animal, or is brought by irritants from rest to movement," and that "the living contractile force must be held to be distinct from the dead contractile force, since the two agree neither in the laws which govern them, nor in their duration, nor in their seat."

This force he calls Vis Insita, the Inherent Force, and the tissues possessing it he calls after Glisson "irritable."

He then discusses whether this property of irritability is identical with that of feeling, and concludes that it is not. "There are many parts which feel, but which are not irritable, and in particular, a nerve, which is above everything sensitive, and yet possesses no contractile force except that common one found, as stated above, even in dead things.

"Wherefore this force since it is different from mere elasticity and from that dead contraction which is common to all fibers, seems to constitute a peculiar property, proper to the muscular fiber, and indeed to mark the character of that fiber, so that every muscular fiber is irritable, and on the other hand you may fairly call muscular fiber everything that is irritable. It is, however, a force of its own kind, different from every other power, and to be classed among the sources of production of motion, the ultimate cause of which is unknown. This same force is inherent in the fiber itself and not brought to it from without.

"I (by my experiments published first in 1739, and again in 1743) separated this irritable nature on the one hand from a mere dead force, and on the other from the nervous force and from the power of the soul. I shewed that the movement of the heart and the irritable nature of the intestines

depended on it alone. I confined it entirely to the muscular fiber, in which point the Batavian school does not agree with me, but they will I hope do so when they are willing to distinguish the contractile force common to all animal fiber from the irritable force proper to muscle alone. I also shewed that that force was something perpetually living, and that it often broke out into movement though no external stimulus such as could be recognized by us was acting. By a stimulus, however, it could at any time be called back from rest into action. In a movement produced through it I distinguished between the stimulus, which might be very slight, and the movement called forth by the stimulus, which might be very powerful."

"Some," says he, "have wished to call this force the vital force, but this does not quite please me, since the force may for some little time survive the life of the body. Hence I prefer to call it the force inherent in or proper to muscle."

Further on he says: "Besides this force inherent in muscular fiber, another force is exercised in it, so far like the former that it alone has its seat in muscular fiber. But it is different from the inherent force inasmuch as it comes from without and is carried to the muscles from the brain by the nerves, it is the power by which muscles are called into action." This he calls the Vis Nervosa. "It too may survive the death of the body, and in cold-blooded animals is of the same constancy as the inherent force; so that in such an animal recently killed, in which no sensation or voluntary movement remains, a muscle, provided it be moist and whole, is thrown into convulsions when its nerve is irritated. And the same is true of warm-blooded animals." Haller reached these conclusions by countless experiments upon the animals, the results of which he reported to the Göttingen Scientific Society, under the title of "De partibus corporis sentientibus et irritabilibus."

In his Elementa, Vol. IV, page 532, he described exhaustively all older theories of muscle contraction and emphasizes that the nerve has no inherent contractility of its own, nor can it move actively in any way, as had been asserted before his time. He reports concerning all former conceptions of the nature of nerve function and declines to believe the electrical hypotheses that arose for the first time in those days, and appears more willing to accept a theory explaining nerve function by the flowing of an actual nerve spirit, not in a gelatinous substance as Borelli thought, but in actual tubes.

In observing the expressions of pain and the movements of defense in the animal during his experiments on irritability, he finds that the sensibility of the various organs depends upon their wealth of nerves. The muscles also possess sensibility, side by side with irritability. The tendons and joints, according to him, do not possess sensibility to a marked degree and the peritoneum very little sensibility. The incompleteness of his physiological technic brought it about that he frequently went too far, particularly with his experiments in stimulating the dura mater and pia mater, as well as the cerebral cortex.

A Character Study of Haller.

To discern the intellectual peculiarity and the inner character of all human beings that have achieved greatness is always a difficult problem. One of the principal features in our philosopher and naturalist is his astonishing pleasure in detail and the second most prominent trait is his unusual joy and power of observation. Biographers frequently speak of the secret of the individuality, and correctly so. It is a secret, but not because individuality is the work of forces which are more subtle and puzzling than other forces. The riddle consists in the abundance and complication of the many coacting forces into which we can very rarely gain exhaustive insight. According to Theodor Gompertz (Griechische Denker) we might distinguish two fundamental types of world sages. In one there is a preponderance of thirst for fullness of knowledge and an insatiable reception of ever new and manifold material of insight. In the second, the most prominent feature is the striving toward inner freedom from contradiction, toward unconditional mental consequentialness and consistency. Insatiable thirst for knowledge on the one hand, and the desire to have a mind free from contradictions, a so-called logical and orderly mind on the other hand, are not necessarily diametrically opposed to each other. The two represent evidently only differences of degree, but the difference is for that reason none the less real. For a critical study of the state of the inner mind of great human beings reveals the surprising fact that these two qualities are rarely present in one and the same individual. Thinkers like Descartes or Spinoza, who erect a homogeneous and uniform thought structure, stone for stone, idea upon idea, and two detail workers like Aristotle and Leibnitz, who are ceaselessly engaged in special investigations of every kind, represent two deviating varieties of a common genus; for the sake of argument we may designate those engaged in restless detail work, the encyclopedists. This human mind may try ever so hard in seeking strict limitation and definiteness of his thought structure, for clearness in the inner arrangement of his mind, yet he will never be as successful as an equally versatile intellect that is not animated by so strong a desire for fullness of knowledge, and hence not equally distracted. Insatiable thirst for knowledge in the encyclopedist must, however, eventually bring about a tendency toward clearing up of his thoughts. Such a man will serve the requirements for the arrangement and the systematization of an enormous mass of knowledge. The encyclopedist will mediate upon and invent artifices and tricks controlling the material of thought. An example of this we have in the language of concepts of Leibnitz; or the encyclopedist will become a classifier and systematizer, and as a matter of fact we find that all great human beings with a comprehensive grasp of knowledge tend toward this achievement. Classification and systematization were the great intellectual feats of Aristotle and Humboldt. But strangely enough the best biographers of both of these do not concede that they accomplished research work of enduring excellence. Aristotle was not a research worker in

the modern sense of the word; his interpretation of actual facts is often wilful and controlled by preconceived opinions. His interpretations show the inexhaustible resources of a head rich in inventive power, rather than the severe training of a mind that conquers its intuition and bows under the hard yoke of facts.

In Haller, however, we find for once a human intellect eminently fitted to serve classification and systematization; he has an orderly, logical, or consequential mind, and an insatiable thirst for fullness of knowledge, but it is conceded by the most capable judges of the present day that he was a research worker "par excellence."

The life of Haller and his works put to shame the sixteenth aphorism of Heraclitus.

πολυμαθίη νόον ἔχειν οὐ διδάσκει.

(Too much knowledge does not give understanding or insight.)

His life rather reminds one as fitting to the celebrated aphorism of Hippocrates,

"ὁ μὲν βίος βραχὺς ἡ δὲ τέχνη μακρή."

(Life is short, but art is long.)

PRIMARY HEMANGIOMATA OF MUSCLE.

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This paper is based upon one personal observation in which a rather extensive hemangioma of the leg was considerably improved after a simple exploratory incision and separation of the muscles, and five cases subjected to operation in Prof. Halsted's clinic of the Johns Hopkins Hospital. These patients have been entirely relieved. In three cases the tumor was completely excised (thigh, abdominal wall and cheek), in two (forearm and calf) there was only partial excision. A review of 129 cases recorded in the literature, making in all 135 cases, is added. Cases I, II, and III are outlined in Bloodgood's pamphlet on Benign Tumors, published in Progressive Medicine, 1903-1905.

I take this opportunity to thank Dr. Bloodgood and Dr. MacCallum for suggestions and assistance in the preparation of this article.

Case I.—Surgical No. 5051, Pathological No. 1215.

Diagnosis.—Intramuscular hemangioma of thigh (quadriceps muscle). Excision. Recovery.

Admitted to the Johns Hopkins Hospital, January 20, 1896.

Clinical History.—White, male, 18 years old, umbrella-maker.

Personal and Family History.—Unimportant. Three and a half years ago the patient observed a swelling on the medial side of the anterior surface of the lower third of the right thigh, about three inches above the patella. The tumor was not painful except after standing up for a long time. As a rule it was soft, but when the muscles contracted it became hard. An operation for the removal of the tumor was performed about a year ago by a doctor outside of the hospital, and the patient was told that the growth was in the muscle itself. Three months after this operation there was a return of the swelling.

Physical Examination.—This was negative except for the right thigh which presented the following condition: There was a tumor about 10 cm. in length by 4 cm. in width, corresponding in a general way to the area described above. There is a scar 6 cm. in length over the tumor, and the skin around the scar is made prominent by the tumor. The mass seems to be somewhat circumscribed, and gives the impression of being within the sheath of the quadriceps muscle and slightly adherent to the bone. It is soft and feels like a lipoma. It does not pulsate, and there is no note as to compressibility, although probably it was compressible as it diminished in size when the leg was elevated and increased in size when the patient stood up. There was no general swelling of the leg or thigh, but 6 cm. above the patella the right thigh was 5 cm. larger than the left. We have before us the clinical picture of a benign tumor.

Urinary Examination.—Negative.

Operation, Dr. Halsted, February 1, 1896. Ether anæsthesia. Tumor exposed by free incision. It had the appearance of a sponge and was made up of numerous dilated vessels, which were filled with blood. It was situated in the quadriceps muscle (vastus internus), and was surrounded by fibrous tissue, which was also quite abundant between the vessels. Possibly much of this fibrous tissue may have been the result of the first operation. The entire angiomatous area in the muscle was excised. Wound closed with silver wire. Silver foil and gauze dressing. Healing per primam. Convalescence uninterrupted. Discharged February 18, 1896.

Gross Pathology.—The mass measures 5 x 4 x 4 cm. The tissue is red and compressible like a sponge. On section it is composed in places of loose and in others of dense fibrous tissue, surrounding spaces filled with blood. This vascular spongy tissue can be seen to infiltrate between the bundles of muscle removed with the tumor. In the center of the tumor there is a cavity like a blood cyst filled with blood.

The naked eye appearance can be well made out in the alcohol specimen. Muscle, increased intermuscular fibrous tissue and spongy angiomatous tissue.

Microscopic Examination.—Report of Dr. Bloodgood. Intermuscular hemangioma, Pathological No. 1215.

In one section there is muscle, fat, and blood spaces The spaces have an endothelial lining and contain blood. The wall is composed of fibrous tissue with spindle-shaped nuclei. In some of the larger blood spaces part of the cavity is filled with blood while the remaining cavity is occupied by cellular granulation tissue which may be looked upon as organization of the thrombus. Where the vessels are few the muscle is about normal, but in the neighborhood of vessels the connective tissue between the muscle bundles is increased, there are more cells and the muscle shows beginning atrophy. In other places there is an excess of normal fat between the bundle of muscles.

In a second section interstitial myositis predominates in the picture, with numerous lymphoid areas. The vessels are smaller and the majority are thrombosed and the thrombus organized.

In a third section vascular fat replacing muscle is the chief tissue. The vessels in this fat are more numerous than normal and have the thick wall seen in the vessels of the previous two sections. None of the vessels show thrombosis.

Numerous other sections show about the same picture.

There is therefore between the muscle bundles a new formation of endothelial lined blood spaces with thick walls. In some areas there is thrombosis with organization of the thrombus. Accompanying this process there is interstitial myositis with atrophy and substitution of muscle tissue by fat.

After History.—The patient was examined again on December 19, 1902. The wound which was healed when he was discharged has given him no discomfort since. There is no restriction of motion at the knee-joint, and apparently no weakness of the quadriceps muscle. There is a depressed scar beginning above the patella and extending about halfway up the thigh. Beneath the skin in this area there is apparently no muscle tissue. When the muscles contract there is a depressed cavity in this area with a strong bundle of muscular tissue on each side. In the centre of the scar there are two dilated veins beneath the skin, the only evidence of the original tumor, there being no sign of angiomatous tissue in the surrounding muscle. The result can be considered a perfect one.

CASE II.—Surgical No. 5809, Pathological No. 1491.

Diagnosis.—Intramuscular cavernous angioma of calf (gastrocnemius muscle). Deformity. Partial excision. Recovery.

Admitted to the Johns Hopkins Hospital July, 1896.

Clinical History.—White, female, 25 years old, teacher.

Family History.—Tuberculosis.

Personal History.—Unimportant.

Fourteen years ago when 11 years old she noticed that she walked on the toes of the left foot. There was no pain. This equinus position has gradually increased and she was unable to put her heel on the floor even with the strongest effort. Up to two months ago there were no other symptoms. Then for the first time she felt pain and tenderness in the calf of the leg, and on examination found the swelling.

Physical Examination.—This was negative except as noted below. The left foot is held in position of extension (talipes equinus). The middle third of the calf is symmetrically larger than that of the right leg. The skin is normal. The swollen area appears to be of the muscles themselves, and is rather diffuse, soft and slightly compressible. Above and below the swelling the muscles are somewhat atrophied, soft and flabby. A diagnosis of chronic myositis was made, and the tendo Achillis divided on July 3, 1896, to correct the talipes equinus. Plaster of Paris dressing.

Discharged July 23, 1896. Improved.

Readmitted September 8, 1896, because of inability to use leg with any comfort, due to increase of pain and tenderness in the calf.

Examination as above except that foot can now be flexed. Extending from the tendinous portion of the gastrocnemius muscle well up to its origin the swollen area feels hard and irregular in outline. It seems intimately incorporated in the muscle. It does not give the impression of a new growth, but rather that of semichronic inflammatory swelling. Deep pressure is painful. There is no swelling of either ankle or knee.

Urinary Examination.—Negative.

Operation, September 9, 1896, Dr. Finney. Ether anæsthesia. Esmarch bandage. On dividing the aponeurosis of the gastrocnemius muscle numerous large veins were exposed, and then angiomatous tissue made up of large and small cavernous spaces and dilated veins. The stroma of the angiomatous tissue was fibrous. The growth had infiltrated between the individual muscle bundles, and these bundles appeared soft and fatty. The gastrocnemius was involved from its tendon to its head, and the operation consisted in the removal of most of the angiomatous tissue and some of muscle. Wound closed with silver wire. Silver foil and gauze dressing. Healing perfect. Convalescence uninterrupted.

Discharged October 8, 1896, walking with a stick.

No gross pathological description except as above.

Microscopic Examination.—Report of Dr. Bloodgood. Intermuscular hemangioma, Pathological No. 1491.

There are no new sections of this case and no material from which they can be made. The one old section shows the histological appearance practically identical with the case just described.

I saw both of these cases in the fresh and remember the appearance distinctly. Between muscle bundles there was a red spongy tissue from which blood could be expressed, and this tissue invaded the muscle irregularly. It was greatest in amount between the larger bundles of muscle. Where the angiomatous tissue was most abundant and the blood spaces were larger, one could see the thicker walls and make out the presence of a larger amount of fibrous tissue. In some of the larger vessels the thrombus was quite apparent to the naked eye.

The replacement of muscle tissue by fat was most evident in the case in which the lesion was situated in the gastrocnemius muscle.

After History.—In March, 1898, the patient writes that she is perfectly well, and can walk miles without pain or discomfort. In December, 1902, six years after operation still perfectly well.

CASE III.—Surgical No. 11,570, Pathological No. 3559.

Diagnosis.—Intermuscular hemangioma, between and partially involving flexor muscles of forearm. Post-traumatic. Partial excision. Recovery.

Admitted to the Johns Hopkins Hospital February 20, 1901.

Clinical History.—White, male, 17 years old.

Family and Personal History.—Unimportant.

Duration of trouble 10 years following injury of the arm. In falling the forearm was suddenly and forcibly flexed on the arm. Immediately he observed a painful general swelling and soon a small lump appeared on the flexor surface of lower third of forearm. Both the posttraumatic general swelling and the lump entirely disappeared in a few days. For two years he had intermittent attacks in which the forearm felt stiff, but no swelling was noticed. For eight years there was absolutely no sign of trouble. About one year ago, without any apparent reason, the forearm began to swell, and a tumor about the size of a pea appeared at the sight of the original traumatic tumor. Then other similar tumors appeared beneath the skin on the flexor surface of the forearm. The last swelling to appear was that in the palm of the hand. There was no pain complained of.

Physical Examination.—Negative except in part involved. There was general increase in the size of the forearm. Beneath the skin on the flexor surface of the forearm, and extending beneath the annular ligament to the palm of the hand there was an irregular rather soft compressible diffuse swelling. When the arm is lowered the swelling increases a little in size, and a slightly bluish color can be seen through the skin; when raised it decreases somewhat in size. The subcutaneous veins are not markedly enlarged. The tumor becomes firmer, larger and less compressible if an Esmarch bandage is placed around the arm. It does not pulsate. The clinical picture is one of angiomatous tumor. A tubercular synovitis of the tendon sheaths of flexor muscles with encapsulated fluid might give a picture somewhat like this.

Urinary Examination.—Negative.

Operation, Dr. Halsted, February 26, 1901. Ether anæsthesia. Incision over tumor on anterior surface of the forearm. A mass of enlarged and tortuous veins was found between the superficial and deep flexor muscles. There was not very extensive involvement of the muscles, although there was definite angiomatous infiltration. All of the angiomatous tissue that it was possible to excise was removed. Wound closed with silver wire, dressed with silver foil and gauze. Rubber protective drain lower angle.

Later the wound filled with blood-clot and broke down. Healed by granulation without infection.

Patient was discharged on March 13. Wound not quite closed over. Motion of fingers perfect.

Gross Pathology.—In the alcohol specimen one can make out muscle, fat, connective tissue, and angiomatous tissue, the lumen of some of vessels being 2 to 3 mm.

Microscopic Examination.—Report of Dr. Bloodgood. Intermuscular hemangioma, Pathological No. 3559.

The histological appearance is so similar to Pathological No. 1215 that it seems unnecessary to duplicate the description.

In both cases the histological findings suggest that the vascular tissue was present first between larger bundles of muscle, and later infiltrated the different bundles. Where the muscle is normal the vessels are small with thin walls and there is no evidence of reactive inflammation. Where the vessels have thick walls we see interstitial myositis up to complete atrophy of muscular tissue. But now and then one observes an island of fairly normal muscle surrounded by this fibrous tissue which forms the wall of blood spaces. Thrombosis with organization of the thrombus is observed only in those areas in which the vessels have thick walls.

After History.—A letter from the patients' doctor in December, 1902, nearly two years after the operation says, "the forearm is flattened where the angioma was removed, and the hand is carried a little flexed. He is working as a coachman. His arm is strong, and the result is satisfactory."

Case IV.—Surgical No. 14,552, Pathological No. 4750.

Diagnosis.—Intermuscular hemangioma of abdominal wall (external and internal oblique muscles). Excision. Recovery.

Admitted to the Johns Hopkins Hospital April 2, 1903.

Clinical History.—White, male, 5 years old.

Personal and *Family History* unimportant. A tumor was observed by the patient's doctor during his first year, near the junction of Poupart's ligament and the anterior superior spine on the left side. He has seen it several times since, and during the last year it has grown considerably. There is no note as to pain.

Physical Examination.—This was negative except that the heart showed marked irregularity in its action.

Special Examination.—On the left side there was a definite tumor, 8 cm. long by 5.5 cm. wide, slightly hour-glass in shape, being somewhat narrower opposite Poupart's ligament. It was situated over the anterior superior spine, extending above it, and also downward over the outer third of the ligament. Its most prominent portion did not extend more than 1.5 cm. above the abdominal wall. The skin over the tumor was a trifle more bluish than the surrounding skin, and contained a few dilated veins. It is not adherent. There was no sign of inflammation. Considerable tenderness was complained of when the mass was pressed against the ilium, and any attempt to cut off the circulation caused pain. There was no pulsation and no bruit could be heard on auscultation. The mass was definitely lobulated and seemed made up of tortuous thin walled veins. In several places, especially just above and inside of the anterior superior spine, is a deposit of calcareous material, the largest mass being about the size of a pea.

The upper limit of the tumor is ill defined, being lost over the crest of the ilium. At the lowest part of the tumor, about 2 cm. outside of and a little above the femoral ring, the veins are nearer the surface and easily seen. The picture presented is that of an angioma with phleboliths. Urinary examination is negative.

Operation, Dr. Halsted, April 4, 1903. Ether anæsthesia.

A free incision over the tumor was carried down dividing the external and internal oblique muscles, close to their attachment to the anterior superior spine. A cavernous angioma was found situated in these muscles and extending under Poupart's ligament. There were also found numerous dilated vessels which bled freely. In order to remove the entire growth it was necessary to chisel off a portion of the ilium, in addition to the excision of the angiomatous portions of the muscles and fascia. Several phleboliths were found. After the bleeding was stopped, the oblique muscles were sutured with silver wire and silk over the edge of the ilium here and there, to prevent subsequent hernia. Skin closed with silver wire. Small protective drain. Silver foil and gauze. Healing per priman. Convalescence uninterrupted. Discharged April 24, 1903.

Gross Pathology.—The mass measures 5 x 5 x 3 cm. It is red and compressible like a sponge. On section it is seen to be made up of fibrous bands separating numerous irregular spaces. Some of these cavernous spaces are filled with blood clot. The spongy tissue can be seen to infiltrate between the muscle bundles. There is considerable increase in connective tissue. Several phleboliths are seen as well as a band of cartilage, the latter having been removed from the ilium.

Microscopic Examination.—Report of Dr. MacCallum. Intermuscular hemangioma, Pathological No. 4750.

The tissue is composed of a rather loose œdematous fibrous tissue in which there are abundant large spaces lined with endothelium and containing blood. These spaces are very irregular in outline and in size and anastomose very freely with one another. They occasionally show in their interior isolated masses of connective tissue covered with endothelium, which are evidently cross sections of papillary projections. The walls of the blood spaces are quite richly supplied with smooth muscle fibers, which bear intimate and definite relation to the space itself. There are also isolated bundles of smooth muscle fibers scattered about in the fibrous tissue between the blood spaces. In some of the blood spaces there are extraordinary thickenings of a fibrous nature in the walls. These have the appearance of sclerotic patches, seen in artery walls, and taken in general a bluish stain. On section they form lenticular thickenings of the wall of the blood channels, and they are possibly analogous, anatomically at least, to arteriosclerotic changes. In parts of the tissue between the blood channels, numerous voluntary muscle fibers are scattered and degenerative changes may be traced in these which lead to the final disappearance of the fibrillar substance, so that they are left mere masses of protoplasm with abundant nuclei, which then look like giant cells. At one point there is a phlebolith, the central portion of which is composed of amorphous granular material, while the rest is grown through everywhere by connective tissue cells.

After History.—A letter dated January 23, 1908, from this patient's doctor says, "the child is in splendid health and has had no trouble of any kind since the operation."

Case V.—Surgical No. 21,790, Pathological No. 8691.

Diagnosis.—Intramuscular hemangioma of cheek (masseter and buccinator muscles). Excision. Recovery.

Admitted to the Johns Hopkins Hospital, January 6, 1908.

Clinical History.—White, male, 23 years old, candy maker.

Personal and *Family History* unimportant. When 5 years old (18 years ago), the patient was severely injured by falling off a horse, several bones being broken and the left cheek injured. The swelling on left cheek has remained since the injury. The size and consistency of the tumor varies, and sometimes when at work it becomes hard and painful. At times by massage, it can be made almost to disappear, but never entirely. The pain is never severe and only occurs on exertion. About a year ago the swelling was lanced by a doctor and only blood was evacuated. He was told it was a network of veins, and it was poulticed, but only temporarily reduced in size. He now seeks relief largely for cosmetic effect.

Physical Examination.—This was negative, except for a slight systolic murmur at apex and base.

Special Examination.—The left cheek is symmetrically swollen, the swelling being most noticeable 3 cm. in front of angle of jaw, and 1 cm. above the ramus, and covering an area of about 5 x 2 cm. The skin over it is normal and not adherent. The mucosa on the mouth side is also normal. It is slightly tender, quite soft, and is not connected with either the upper or the lower jaw. Near the upper jaw there is a small pea-like nodule, which is hard and smooth and moves about quite freely. It seems nearer the mucosa than the cutaneous surface. On careful palpation one can also distinguish a separate, movable, soft, and slightly compressible mass (about 2 cm. in diameter) which feels somewhat like fat. A filiform probe was introduced into Steno's duct, and passed back to the parotid gland, the duct being readily palpated on the probe throughout its length. There was no thickening nor induration along the duct, and the tumor mass was not connected with it. The small hard nodule just described, was above the duct and separate from it. A diagnosis of angioma was made.

Urinary Examination was negative.

Operation, Dr. Finney, January 13, 1908. Ether anæsthesia.

The tumor, with portions of the muscle, was completely excised through a horizontal incision in the cheek, and was found to be a large cavernous angioma, involving the masseter and buccinator muscles, and probably some of the smaller muscles of the cheek, although these could not be identified. The tumor extended from the malar bone back almost to the ascending ramus of the jaw. Three phleboliths were found. There was considerable hæmorrhage. The wound was closed with interrupted silk sutures. Small protective drain, silver foil, and gauze dressing.

Drain removed in 24 hours, and stitches in 48 hours. Healing per primam. Discharged January 16. To return for observation.

Gross Pathology.—The mass presents the picture of a typical cavernous angioma with red spongy tissue and great increase of fibrous connective tissue. The spaces are very irregular, and are separated by fibrous bands. They contain blood. Several phleboliths are seen.

Microscopical Examination.—Report of Dr. MacCallum. Intermuscular hemangioma. Pathological No. 8691.

The specimen is made up of spongy tissue. The ramifying spaces of which are lined with endothelium, and are filled with blood. These spaces anastomose very freely with one another and are entirely irregular in size and form. In many places the intervening tissue appears in the section in the form of isolated masses lying free in the blood filled space and covered with endothelium. Generally such masses have a central artery. One or two of the blood spaces contain thrombi. In one instance it was almost completely organized and permeated by new-formed blood capillaries. The tissue itself between the blood spaces, is composed of fairly dense fibrous tissue with quite abundant minute blood-vessels. There is a good deal of blood pigment scattered in this tissue, but wandering cells are not abundant. Indeed the cells of the tissue itself are not abundant, but it is composed chiefly of wavy fibers which take a deep eosin stain. There are occasional isolated bundles of smooth muscle fibers in the tissue forming the walls of these anastomosing channels. This is very irregularly arranged. At one point in the section, there is a large round mass, composed of concentric layers of dense hyaline fibrous tissue. In the center this has lost all cellular structure, and is converted into a homogeneous, gray, granular material. The outer layer shows some blood pigmentation.

Both of these cases are good examples of cavernous hemangiomata of muscle.

After History.—As this goes to press, there is still some post-operative swelling of the cheek, which is becoming less from day to day.

CASE VI.—

Diagnosis.—Varicose veins of leg. Excision. Recovery.

Venous angioma of muscles of the front of the leg (tibialis anticus, extensor longus digitorum, extensor proprius hallucis, and peroneus tertius) found at operation for excision of veins. Exploration. Improved.

Admitted to the Robert Garrett Children's Hospital, June 23, 1905.

Clinical History.—White, female, 12 years old, schoolgirl.

Family History.—Negative.

Personal History.—Unimportant, except birth after prolonged labor and forceps delivery. Has always been well. Several days before admission she scratched one of the enlarged veins on her leg, and profuse hæmorrhage followed. She has had trouble with the left leg since birth, the veins having always been swollen. In October, 1901, she was admitted to the Johns Hopkins Hospital for profuse hæmorrhage due to scratching dilated vein. The superficial veins of the outer side of leg, which were much enlarged, were divided and tied at that time. Healing per primam. Convalescence uninterrupted. There was little permanent improvement following this operation. She says, "the leg does not swell, and there is no pain except on striking it."

Physical Examination.—Strongly built, well nourished girl. Normal throughout except in the leg affected.

Urine shows trace of albumin, otherwise negative.

Special Examination.—Left leg. No bleeding point or evidence of ruptured vein. Just below and to outer side of the knee is a T-shaped scar of the old operation. Superficial veins of leg are considerably enlarged. There is slight general swelling with several nodular areas at various points, which are tender on pressure. One of these at the intersection of the lines of the T-scar is small, hard and very tender, and gives the impression of a foreign body. There are three others, one in front of the middle third of the leg, one on the inner side of the lower third, and one in front of and extending a little below the external malleolus. These average about 4 cm. in diameter, are raised about 1½ cm., and are roughly in circular in shape. They are somewhat compressible and depend on the venous circulation, in as much as they become larger as the patient stands up. On the inner aspect of the swelling on the lower third of leg there is a hard nodule about the size of a bean. There is a small bunch of enlarged veins outside of the ankle and above the malleolus, otherwise the skin has a normal appearance. The kneejerk is not exaggerated. Muscular power of the leg is good. Child walks without limping.

Measurements.—Lying down: Right leg below knee, 25 cm.; right calf, 25.5 cm.; right ankle, 18 cm.; left leg below knee, 26 cm.; left calf, 26 cm.; left ankle, 19 cm.

Standing up: Left leg below knee, 26 cm.; left calf, 26 cm.; left ankle, 19 cm.

This shows no general increase in size on standing, although there was decided enlargement while the patient stood up in the nodular swellings described above The measurements show the left leg to be about 1 cm. larger than the right.

Diagnosis of varicose veins was made with possible foreign body at junction at arms of T-scar, probably buried suture from former operation.

Operation, Dr. Platt, July 5, 1905. Under ether the painful mass at intersection of lines of scar was explored, and a very dense mass of scar tissue found and excised, but there was no foreign body in it. Wound was closed. Later a blood-clot formed. Wound broke down, and healed by granulation without infection.

The patient was passed on to me when my summer service began at the Garrett Hospital, and an operation for the excision of the varicose veins was decided on.

Operation, August 2, 1905. Ether anæsthesia.

Long incision in front of tibia to outer side of ankle. Skin stripped back and many varicose veins excised including the swellings on the leg noted above, which were masses of dilated veins. The hard nodule in the lower one was a phlebolith and

grated under the knife. The mass in front of the ankle was under the fascia and not in the subcutaneous tissue as the others had been. It was bluish-purple in color and gave the impression of a cluster of enlarged veins shining through. On splitting the fascia the mass ballooned out into the wound, and when this opening was continued to the full length of the skin wound there was considerable bulging of similar tissue throughout. This bulging mass turned out to be the tibialis anticus, the extensor longus digitorum, extensor proprius hallucis, and peroneus tertius muscles, the fibers of which were replaced to a large extent by a network of coiled and tortuous blood-vessels, the largest being about the size of a lead pencil. (This is the only case on record in which these muscles are involved.) The vessel walls were quite thin and had the appearance of veins. The bundles of muscle fibers between which they ran in every direction seemed normal and in no way pale or fatty, but were quite scanty, in fact, it seemed that the muscular tissue was almost entirely replaced by the mass of vessels. There was little more adipose and connective tissue than would normally be seen. The tissue was soft, compressible and spongy. There was no pulsation, and no phleboliths were palpated. *This angiomatous condition was unsuspected up to the time when the fascia was opened.* The question of excision of involved muscles, or at least portions of them was considered, but as there had been no symptoms except the presence of external varicose veins, and as the muscles were functionating perfectly in spite of the great increase in vascular tissue it seemed best not to excise. The muscles were then separated from their attachments to the bone and surrounding tissues as far as possible, in the hope to produce scar tissue. No especial feeder was found running to the angiomatous mass. At this point the condition of the patient, who had not taken the anæsthetic at all well, became very bad, and rapid closure was necessary, so unfortunately a portion of the tissue was not excised for examination. I was unable to close the fascia until the leg was held upright and the muscles milked, after which the tissues rapidly resumed their normal size, and closure was easily made with interrupted silk sutures both in fascia and skin. Small gauze drain at lower angle of wound. Silver foil, gauze and pressure bandage. First dressing on third day. Drain and three lower stitches removed. All stitches removed on tenth day. Healing per primam in all but lower two inches where the skin edges had separated somewhat. This healed by granulation. Convalescence uninterrupted. Flannel bandage.

Discharged August 31, 1905, 29 days after operation.

Measurements.—Left leg below knee, 24.75 cm.; left calf, 25.25 cm.; left ankle, 18 cm. The leg is generally somewhat smaller as the measurements show. No enlarged veins are to be seen. There is, however, still under the lower widened portion of the scar the swelling in front of the outer malleolus.

After History.—The patient was seen in August, 1907, two years later. She says she is much improved in every way, and with the aid of a rubber stocking is able to get about without any discomfort. She has grown considerably since discharge. Examination shows the superficial veins are again prominent both on front and back of leg, and also in popliteal space. The lower portion of the scar has spread and is about 2 cm. wide. The mass under this spread portion of the scar is much smaller than when the patient left the hospital, and can scarcely be noticed. There is the sensation of the pricking of pins, and often there is jerking of the leg and much discomfort when the edges of the spread portion of scar are stroked with the finger, but this sensation passes off when pressure is applied. She complains of some discomfort after running or standing for a long time, in the outer posterior portion of lower third of thigh, extending down to the popliteal space. This area is slightly tender on palpation. Examination, otherwise negative. Veins of thigh are not enlarged. The left leg and thigh are smaller than the right, actual measurements showing 2.5 cm. difference. Both ankles measure the same. The difference in measurement is probably due to her saving the left leg somewhat. Motion of foot and leg is perfect. Except for a feeling of fullness and tingling when she walks without the stocking there is much improvement in the clinical condition, although the angiomatous growth itself is probably not materially modified. Gradual withdrawal of the stocking and massage advised. Further operative procedures to be considered later if necessary.

Historical.—The first case in the literature is that described by Liston in March, 1843, which he called an erectile tumor in the popliteal space, and which turned out to be an angioma of the semimembranosus muscle. In considering the subject in the following résumé I have taken up only those angiomata of the voluntary muscles, which develop in the muscle itself, and have not invaded the muscle secondarily from neighboring structures, such as the skin and subcutaneous tissues, as in the cases of Poland, La Morier, Cranwell, etc. Angiomata of the muscles of the tongue (except the case of Rigaud) and of the lips have been omitted as it is difficult to discover the primary origin in the majority of these cases. Lymphangiomata have also been omitted except where they occur with hemangiomata, as in the case of Monzardo, although it is claimed by some that all hemangiomata of muscle are primarily lymphangiomata, and that the blood secondarily enters the lymph lacunæ. The older writers on cavernous angioma of muscle always spoke of it as an erectile tumor, and often it has been compared with the erectile organs. The gross appearance of a cavernous angioma and true erectile tissue is undoubtedly quite similar, but as Rigaud remarks, the comparison cannot well be made when we consider that the variation in the volume in the true erectile tissue is due to the influence of vasomotor and sensory nerves, while variation in the size of an angioma is due simply to mechanical pressure of the blood. In other words, the erectility of an organ, such as the corpus cavernosum is an active erectility, while that of a cavernous angioma is a passive erectility.

Definition.—An angioma of the muscle is a tumor due to the proliferation of preexisting vessels in a certain district of the vascular network of the muscle, forming a simple angioma; or to proliferation, dilatation, and sometimes fusion of the vessels which transmit the blood from the arteries to the veins, forming the cavernous variety. Its origin is either congenital or traumatic, and its appearance when congenital may be favored by traumatism. As the disease progresses there are observed perithelial and endothelial proliferation with a cellular and fibrocellular connective-tissue production around the vessels, and an interstitial myositis with atrophy, and in some cases (Case II) a substitution of adipose tissue.

Etiology.—There is considerable difference of opinion as to the etiology of angiomata, and numerous theories have been advanced. Virchow says they are due to disease of the vasa-vasorum and dilatation of preexisting vessels; Rindfleich and Rokitanski that they develop separately from the circulatory system, and secondarily communicate with the vessels; Esmarch that proliferation of normal vascular walls cause angio-

mata; Honsell rather inclines to the idea of vascular fibromata; Monzardo that increase of vascular tension in the territory of the seat of the tumor is the pathogenic cause; Riethus that they are congenital anomalies, and Wardrop that they are always congenital anomalies. Sutter in his very comprehensive paper writes that angiomata of muscle are probably primarily congenital malformations in the vessels which may only be noticed in later years, and thinks that obstruction to drainage due to proliferation of the coats of the vessel walls and damming back of the flow in the interior of the tumor probably cause the formation of the venous and cavernous spaces. There are cases reported, however, which undoubtedly have followed trauma, as Cases III and V. The consensus of opinion seems to point first, to a congenital origin, in which class the majority of the tumors belong; second, to a traumatic origin with the possibility of both, that is, having an injury to a part in which the congenital anlage exists. It is thought that muscle angioma has its origin from a certain district of the vascular network of the muscle. However, there is no particular afferent or efferent vessel in the majority of cases, that of Fornari being the only one reported with a definite afferent vessel. It is also possible that friction, due to the location of the tumor, and the action of the voluntary muscle in which it is situated may have a part in the development. Angioma of muscle is independent of nævus of the skin. Most of the cases are in children or young adults, and are about equally divided as to sex.

Geographical Distribution.—It is not possible to point out any definite geographical distribution, although the literature shows most of the cases from Italy, France, and Germany. This, however, is probably due to the fact that more interest has been taken in this class of tumors in these countries, and, therefore, more cases have been reported. There have been comparatively few cases reported in the United States, those of Agnew, Bloodgood, Gross, Keen, Senn, Summers, and Thorne being the full list as far as could be found.

Personal history, social condition, occupation, and dietary influence add nothing of importance to the etiology.

Heredity.—Transmission of primary muscular angioma from parents to children, or the occurrence of this tumor in two children of the same family has never been recorded. Therefore, it seems that heredity also plays an unimportant part in the etiology.

Race.—All the cases reported are in the white race except those six published by Nagatomi, which were in Japanese. As the proportion of negroes to whites admitted to the hospitals in this section of the country is very much greater than further north, it is interesting to note that Cases I-VI inclusive, were all in whites.

Symptoms.—These clinical symptoms are based on the entire literature and on the cases reported here. There is no peculiarly definite symptom. The tumor is often noticed early in life, and is slow growing. "As a rule, it remains latent until causes of which at present we have no knowledge induce it to grow more rapidly."

There is pain in many cases, and this seems to be the most constant symptom (Cases I, II, III, IV, and V). It may be slight or very intense. It may be continuous or only appear on motion (Case V), and it may even occur periodically, as in Keller's case, where there was pain only in the spring and fall. The pain is probably due to pressure, as it would be difficult for the tumor to develop in a limited space without causing pressure on the nerve trunks. Tenderness on palpation is very marked in some instances (Case IV). There may be numbness of the extremity, followed by heat and burning, or occasionally the sensation of formication, tingling and fullness, as in case reported by Magon. Sometimes there is loss of function of the part involved. The symptoms may be so little pronounced that attention is drawn to the growth only by its size interfering with work or with the comfortable adjustment of garments. Occasionally the tumor is found at autopsy, no symptoms having been complained of during life. Sometimes the growth is discovered during an operation performed for the relief of some other trouble, as in Case IV, where the tumor was chanced upon during an operation for varicose veins. The cause of the varicose condition of the veins of the leg in a child of this age, 12 years, was discussed before operation, but no definite conclusion was reached in her case. It might, however, be well to bear in mind in future that varicose condition of veins of leg in children can be caused by an angioma of the muscle, and the tumor itself not be discoverable by swelling or any other symptom, and only demonstrable by operation.

Diagnosis.—The diagnosis until recently was seldom made before operation, the comparative rarity and depth of seat being the two principal reasons for this difficulty. Now, however, it is recognized more often. An angioma may be situated in any voluntary muscle. The skin over the tumor is usually normal and can be lifted in folds, but now and then it is adherent. The superficial veins are in some instances enlarged and tortuous, as in Cases IV and VI. Occasionally there is pulsation in a cavernous angioma in the early stage, as in Liston's case, and Matsuaka reports a case of pulsating cavernous angioma in the later stage. This pulsation may possibly be transmitted from a neighboring artery. There may be a souffle also, but these are very uncommon phenomena in connection with this tumor. The tumor is usually soft but it may be hard and elastic. It may be smooth or there may be lobulation. Its consistency to touch changes with contraction and relaxation of the muscle. It may be movable laterally when the muscle is not in a state of contraction. It is not as a rule sharply defined, and in some cases shows a tendency to spread. When diffuse it is difficult to make out the exact size by inspection or palpation. Some are completely reducible, as in Magon's case, some are partially reducible, Case III, and some cannot be reduced at all, as in Nagatomi's case. Compressibility has long been looked on as one of the most important points in diagnosis, although it cannot be absolutely depended upon. Change in position of the limb causes change in size of the tumor in many cases (Case I). An Esmarch bandage applied above often causes

diminution in size and sometimes complete disappearance of the tumor. The size of the tumor varies from that of a pea to that of a small pumpkin, but most of them are about the size of a pigeon's egg or smaller. Rigaud says that primary angiomata are always circumscribed, single and small, and secondary angiomata are always diffuse, multiple and large. These facts are not borne out by the statistics which follow. *Phleboliths* can often be palpated (Cases III, IV, and V), and on this account the X-ray has been used as an aid in diagnosis. In Mahar's case, however, the shadow of a "vein stone" was so close to the bone that a diagnosis of bone tumor was made. Sometimes areas of bone formation, so-called ossifying angiomata, and osseous lamina are found in angiomata of muscle, but these structures can probably be explained as exostoses, which invade the tumor, and in the struggle are cut off from the point of origin and absorbed. *Deformity*, as in Case II, due to angioma of muscle has of late received considerable attention, and in a paper by Putti on this subject he speaks of the deformity being used as an aid in diagnosing the obscure condition in certain cases. *Exploratory puncture* is used frequently as a means of diagnosis, and if normal blood is withdrawn, and the tumor rapidly regains its original size, it is evident that it is a vascular growth, and probably an angioma. There seems to be a moderate preference for the lower limb in the location of the tumor. Kuttner quotes Bayha and von Hippel as saying that congenital cavernous angiomata have been observed to increase in size at puberty; also Pitchler, who makes the very interesting statement that a cavernoma of the liver never occurs before puberty. We can realize the difficulty in making an accurate clinical diagnosis when we consider that the diagnoses mentioned below are some that have been made, before operation, of tumors turning out to be angiomata of muscle.

Differential Diagnosis.

Lipoma.—Angioma of muscle is most frequently diagnosed lipoma, and there are many points of similarity. A lipoma of muscle is as a rule soft and somewhat lobulated. It gives the impression of being slightly reducible. There is little pain either spontaneous or on palpation. It is slow growing. All of these characteristics may be found in muscle angiomata. However, we must remember the great rarity of a primary lipoma of muscle, and it has been said that when a primary intermuscular tumor is found it is best to systematically reject the diagnosis of lipoma.

Sarcoma.—Primary sarcoma of the muscle is exceedingly rare, so we must consider especially those sarcomata arising from the fascia between the muscle and skin, the connective tissue between the muscle bundles and from the tendon sheaths. The intermuscular sarcomata are hard to differentiate in their early stages from the benign connective tissue tumors, which may occur in the same region. The skin is usually normal. The growth is very rapid and often follows injury. The tumor is soft and occasionally seems to be slightly reducible, and also gives the impression of fluctuation. It is seldom encapsulated, but may be circumscribed. There is no difference in size with change of position. In all doubtful cases exploratory incision is imperative, and the naked eye appearance is characteristic of the various varieties, such as lymphangiosarcoma, endothelioma, hemangiosarcoma. Recovery from radical operation in these cases is rare, the patients dying within a comparatively short time of metastases, unless operated on very early, and the growth completely excised. The malignancy of spindle cell and round cell sarcomata varies with the number of round cells, and it is often very difficult to differentiate a sarcoma from a fibroma.

Hemangiomatous Elephantiasis.—The skin is normal. The tumor is slow-growing, firm, lobulated, compressible in places, usually circumscribed. If the limb is elevated for some time the tumor becomes somewhat smaller; if lowered, it becomes harder and more tense. To the naked eye the growth shows brownish-red spongy tissue in certain areas, surrounded by dense fibrous tissue. Microscopically we get the picture of a fibrous and lymphatic elephantiasis with angiomatous areas. In the cases described all of the tumor could not be removed without amputation of the limb. There have been no recurrences and no metastases.

Syphiloma of Muscle.—This is common, and many of the cases formerly diagnosed sarcomata were gummata. They may be single or multiple. It occurs late in the disease. Pain and tenderness are sometimes present. It is movable at first, but may adhere to the skin and ulcerate later. A definite specific history and disappearance of the tumor under proper treatment will aid in differentiation. An exploratory incision will show a characteristic, firm, central necrotic area with zone of infiltrated muscle outside of this.

Chronic Myositis.—The differentiation clinically from innocent and malignant tumors is difficult. It is a chronic inflammatory infiltration, and degeneration, secondary to traumatism or long-continued pressure. The skin may be adherent and indurated. There is local pain and tenderness, and the swelling is hard and more or less diffuse. The X-ray shows a shadow more dense than that of the normal muscle. There is no bony change. An exploratory incision shows that the muscle bundles are firmer and paler. The intermuscular connective tissue is increased. There are muscle bundles between masses of young cellular or old fibrous connective tissue. It does not appear like a new growth. Microscopically there is great increase in the fibrous connective tissue, and atrophy and beginning degeneration of the muscle bundles. Trichinosis can be excluded.

Tuberculous Myositis.—This may occur in any muscle. As a rule there is no pain or tenderness with the swelling, and it cannot be distinguished from other forms of myositis. An abscess often follows this condition. The diagnosis is sometimes difficult if there is a deep-seated cold abscess; careful examination, however, may disclose a focus of disease in a bone or neighboring joint from which it comes. In tuberculous myositis an exploratory puncture will show thin serous fluid with caseous detritus, and this was formerly the only

sure way of making a diagnosis without incision. Now the tuberculin test may be utilized as an aid in diagnosis in both of the conditions just mentioned.

Primary Myositis Ossificans.—It is caused by trauma either slight and frequent, or single and severe. There is a question as to whether the ossification arises from the connective tissue cells, as claimed by Vulpius, or from strips of periosteum detached by the trauma, such as Berndt has demonstrated. The latter view seems the most probable. The growth appears as a rule at particular points in the muscular system, as in the adductor longus of the thigh in horseback riders, called "rider's bone," and in the pectoralis major in soldiers, called "the drilling bone," both being due to constant slight injuries. It is hard and bony; the skin is normal. The tumor may or may not be adherent to the bone. It is not compressible. Sometimes there is a soft crepitation. The X-ray is of great aid in diagnosis.

Fibroma of Muscle.—This is not common. Several cases have been reported in the abdominal muscles following pregnancy in the female, and trauma in the male. It is hard, never fluctuates, and as a rule its boundaries are well defined. The growth is quite rapid.

Hernia of Muscle.—There are two general varieties—true and traumatic. The true muscle hernia is very rare. It develops insidiously and is easily seen when the muscle is at rest. It disappears entirely when the muscle is passively stretched, and also when the muscle is contracted with resistance. The traumatic variety always follows injury. It appears suddenly and is a soft tumor. It feels elastic during moderate contraction, and hardens during full contraction. It subsides entirely during relaxation. The vent in the fascia can be felt in some instances. From the above characteristics it is not a difficult matter to differentiate either the true or traumatic hernia from an angioma of muscle. In lacerated wounds of the skin and muscle the œdematous granulation tissue thrown out by the muscle is unusually vascular, and might suggest a previous angioma.

Hematoma.—Although it seems that the sign of hematoma is quite characteristic, nevertheless an angioma of muscle has been mistaken for it. It is due to a rupture of intramuscular vessels following trauma. It is especially common in the abdominal muscles as well as in the superficial muscles of the body and limbs. The tumor appears shortly after injury, and fluctuates but is not reducible. At first, exploratory puncture shows very dark blood, but later when coagulation has taken place only serum may be withdrawn. In the walls of an old hematoma calcification may take place, and then it is difficult to distinguish it from a fibroma or an osteoma.

Hydatid Cysts of Muscle.—These have been diagnosed before operation in a very few cases, but must always be thought of. The tumor is round or fusiform, may fluctuate or be elastic to touch. It is painless and develops slowly. They have no particular location, and no constitutional symptoms. An exploratory puncture will show a perfectly clear fluid, in which sometimes one can find the characteristic hooklets with the aid of the microscope.

Dermoid Cysts.—These never occur in the muscles of the extremities, but they are sometimes found in the jaw under the muscles.

Primary Carcinoma of Muscle.—It has never been found. A metastatic muscle carcinoma is almost unique, except in the pectoral muscle secondary to breast carcinoma, or in the abdominal wall following carcinoma of the stomach.

Sometimes, however, it is necessary even after excision, in small atypical angiomata, to examine the growth microscopically in order to decide absolutely on its character.

Pathology.—Angiomata of muscle are divided into two general classes:

Simple or Telangiectatic	Capillary, Venous, Arterial	Rare	Circumscribed	Rare	
				or	
Cavernous	—	More frequent	Diffuse	Common	

We find often, however, all the divisions of the simple variety in addition to the cavernous in different portions of the same tumor.

On section the tissue is red or brownish-red, and gives the impression of a blood-filled sponge. It has also been compared in gross appearance to placental and splenic tissue. It is more or less compressible. One can see spaces filled with blood and surrounded by connective tissue, which is loose-meshed in some places, and dense in others; the muscle bundles remain unchanged, or are seen in various stages of degeneration between which the angiomatous tissue infiltrates; the intermuscular fibrous tissue is increased; there are islands of fat; the mouths of the dilated vessels gape; and spongy angiomatous tissue is found. In some cases there is practically nothing but a mass of thin-walled veins (Case VI)! in others there is considerable increase in adipose tissue (Case II); and on the other hand, in others the connective tissue is most marked. The tendons and nerve trunks are rarely affected, and large arteries are usually normal. The striated muscle in which the tumor forms has apparently a perfectly passive rôle.

With higher magnification the following changes in the tissues mentioned are noted:

Striated Muscle Tissue.—It is unaffected where the connective tissue growth is slight, but where it is plentiful we find all stages of metamorphosis (Case IV). The muscle bundles atrophy as the connective and the angiomatous tissue augment, the degeneration being due to pressure and lack of nourishment. A few included striated fibers are occasionally found in the depth of a diffuse tumor. The muscle fibers simply have the relation of contiguity with the circumscribed angioma which grows between the fibers, and pushes them aside, never including any of them in its depths.

Smooth Muscle.—It predominates in some places and seems to originate from the proliferation of the muscular coats of the vessels, from arterioles and veins respectively, according to some authors, but probably from both (Case IV).

The Connective or Fibrous Tissue.—This originates from the perimysium (Muscatello), or from the adventitia of the

arterioles and veins (Reclus and Magitot), and forms the framework of the angioma. It is found in all stages of development, and may be diffuse or scanty. It may condense at the periphery and form a capsule. Karyokinesis is occasionally seen in the nuclei of the connective tissue cells.

Adipose Tissue.—It is more or less abundant among the connective tissue meshes and between the muscle fibers, and is not a special element of the new formation, but is simply tissue replacing destroyed muscle. It is a well known pathological fact that when any highly specialized tissue is destroyed, adipose tissue usually replaces it.

Elastic Tissue.—By proper staining this is seen to run everywhere throughout the tumor.

Nerve Filaments.—Both these in the muscle, and occasionally nerve trunks become included in the tumor, more often than microscopic examinations seem to show, and this probably accounts for the pain and trophic disturbances, which are present in so many angiomata of muscle. The nerve fibers resist degeneration better than the muscle fibers, and seldom appear much involved.

There may be found in the same tumor a simple and a cavernous portion, but an angioma may be purely simple or purely cavernous. Reclus and Magitot say, however, that it is easy to trace the changes from the simple to the cavernous variety; Rigaud that the growth always begins with a simple angioma, and that the cavernous variety is a later and exaggerated form of the simple variety, and if the angioma ever reaches the cavernous stage it never recedes; Mauclaire and Bovis that the capillaries are formed first, then the veins and arteries. The changes in the vessels are generally as follows, and as a rule the vessels and cavernous spaces contain normal blood.

Capillaries.—They are most important. They proliferate and buds are sometimes seen coming from the walls and karyokinetic figures in the nuclei of the endothelium (Muscatello). Each capillary has a wall of its own and the lumen varies in size. Instead of a single layer of endothelium there may be two or three. The capillaries finally dilate, fuse, and form the cavernous spaces (Sutter). Rigaud says, however, that the number of capillaries always remains the same, and that there is never any fusion of two or more capillaries to form lacunæ, but the lacunæ are due entirely to dilatation.

Veins.—New vessels are formed with the structure of veins. the walls may be thickened, or dilated and atrophied. The lumen is sometimes normal, but often is irregular. The dilated vessel may form the irregular venous space cavities, which are probably the result of obstruction (Sutter). Thrombi in all stages of organization and phleboliths can be found in many of the tumors both in the varicose veins and in the lacunæ. There is some difference of opinion as to the origin of phleboliths. Rokitanski believed they were calcified blood coagulations, and this theory might also be adopted for their formation in an angioma of muscle; Cornil, that phleboliths existing in angiomata have the same origin as those found in veins, and that they are derived like those from fibrous products that come from the vessel wall and then undergo calcareous infiltration. Bajardi thinks that phleboliths occur in the lacunæ and also probably more frequently in the dilated varicose vessels existing here and there in the tumor. This idea is probably correct. In both situations it is preceded by a thrombus and its successive organizations (Cases IV and V).

Arteries.—Many of the small arteries show either eccentric or concentric thickening of the walls, with increase in smooth muscle fibers. The lumen is normal or somewhat smaller, and the endothelial lining is thickened.

Cavernous Angiomata.—They are the most common and have the characteristic lacunæ, which are formed in most instances by the dilatation and fusion of the capillaries. The lacunæ vary in size, are lined by endothelium, and contain normal blood. There is said to be no endothelial lining to some of these spaces, and the blood is in direct contact with the connective tissue and smooth muscle surrounding them. Around the spaces is a framework of connective tissue and smooth muscle carrying arteries and veins. The spaces are subdivided by connective tissue partitions, which are thick if the connective tissue is abundant, and thin if it is scanty. The partitions are covered with endothelium, and some are so thin as to bring endothelium back to back. In places the partitions do not reach across the spaces and give the appearance of valves. These formations seem to depend on the proliferation of the connective tissue and not on atrophy of preexisting tissue due to pressure of the blood. In Case I we find in the center of the tumor a large cystlike cavity filled with blood. This cavity is very much larger than any ordinary lacunary space, and is probably due to the breaking down of the walls between these spaces by the pressure of hæmorrhage due to injury to the tumor. There may be collections of leucocytes in the connective tissue, which resemble lymph follicles, or marked round cell infiltration and considerable collection of connective tissue nuclei with very little intercellular substance, both of which suggest sarcoma.

Dr. Cushing tells me that he has never had a case of primary muscle angioma in the Hunterian Laboratory of the Johns Hopkins Medical School, and the only mention I can find in the literature, of angioma in animals was of Petit and Pagnon, who describe multiple subcutaneous cavernous angiomata in a dog.

Rau reports a case found at autopsy of cavernous angioma the size of a cherry in the wall of the right auricle in a man 52 years old.

Prognosis.—The majority of angiomata of muscle are benign, but we find sometimes with the microscope a round or spindle cell infiltration, which points towards malignancy. However, there is a tendency for the angioma to invade the surrounding tissues in some instances, as noted by Putti, and possibly to metastasize to other portions of the body, but this latter is very doubtful. There have been local recurrences after excision in several cases of the diffuse variety, probably because all of the tumor substance was not removed, but this is rare. Partial excision, on the other hand, has effected perfect cure in many other cases (Cases II and III). The

Author.	Reference.	Age.	Sex.	Duration.	Location.	Treatment.	Result.	Remarks.
Agnew	Agnew's Surgery, 1883, Vol. III, p. 389.	(?)	F.	Congenital.	Abdominal muscles.	Excision.	Recovery.	
Alessandri	Policlinico, Roma, 1904, XI, p. 117.	20	F.	4 yrs. Rapid growth 2 mos.	Trapezius.	....do.	....do.	Cavernous angioma. Pain. Fluctuation.
Allier	Cit. by Coletti.	(?)	(?)	....(?)	Pectoralis major.	....(?)	....(?)	
Anziolotti	La Clinica Moderna, 1903, p. 508.	20	M.	About 3 yrs.	Orbicularis palpebrarum.	Excision.	Recovery.	Arterial angioma. Circumscribed. Pain.
Auvray	Tribune Méd. Par. 1905, XXXVII, 21.	20	F.	2 yrs.	Vastus internus.	....do.	....do.	Capillary angioma. Pain. Diagnosed arthritis.
Bajardi	Clin. Med. Pisa, 1900. VI. 339.	12	M.	More than 1 year.	Gluteus medius.	....do.	....do.	Cavernous angioma. Circumscribed. Pain. Diagnosed false neuroma.
Do.	.....do.....	10	F.	Congenital.	Masseter.	....do.	....do.	Cavernous angioma. Diffuse. No pain. Phleboliths.
Do.	.....do.....	Young	F.	2 yrs.	6th intercostal.	....do.	....do.	Cavernous angioma. Diffuse. Pain. Diagnosed costal caries. Endothelium of capillaries continuous with that of cavernous spaces.
Do.	.....do.....	22	F.	12 yrs.	Flexor longus digitorum (foot).	....do.	....do.	Arterial, capillary and cavernous angioma. Pain. Posterior tibial artery and nerve involved by the tumor. Osseous lamina not connected with tibia.
Bayha	Deutsche Zeitsch. für Chir. Vol. LI, p. 200.	25	F.	10 yrs.	Triceps muscle.	....do.	....do.	Capillary venous angioma.
Do.	.....do.....	17	M.	3 yrs.	Trapezius and latissimus dorsi.	....do.	....do.	Capillary venous angioma.
Do.	.....do.....	5	(?)	2 yrs.	Supinator longus.	....do.	....do.	Cavernous angioma. Phleboliths.
Do.	.....do.....	18	(?)	Congenital.	Vastus externus.	....do.	....do.	Cavernous angioma.
Bellouard	Cit. by Rigaud, Thèse de Paris. 1903.	(?)	(?)	....do	Sacro-lumbar muscles.	....(?)	....(?)	
Berard	Cit. by Sutter.	(?)	(?)	....do	Vastus externus muscle.	....(?)	....(?)	
Berger	Cit. by Rigaud, Thèse de Paris, 1903.	(?)	(?)	....do	Back muscles.	Excision.	Recovery.	Cavernous angioma.
Do.	.....do.....	(?)	(?)	....do.	Flexor carpi ulnaris.	....do.	....do.	Cavernous angioma. Phleboliths.
Biblioth	Cit. by Rigaud, Thèse de Paris. 1903.	(?)	(?)	....(?)	Trapezius.	....(?)	....(?)	
Bichat	Cit. by Alessandri.	(?)	(?)	....(?)	Triceps.	....(?)	....(?)	
Boekel	Cit. by Rigaud.	(?)	(?)	5 yrs.	Quadriceps femoris.	....(?)	....(?)	
Bonnet	Thèse de Toulouse, 1894.	24	M.	1 yr.	Vastus internus.	Excision.	Recovery.	Simple angioma.
Bossalino	Cit. by Alessandri.	17	M.	5 yrs.	Right rectus of eye.	....do.	....do.	Cavernous angioma. Circumscribed.
Billroth	Virchow's Archiv, VIII, 264.	(?)	(?)	....(?)	Latissimus dorsi, deltoid.	....do.	....do.	Cavernous angioma.
Le Gros Clark	Cit. by Sutter.	(?)	(?)	....(?)	Latissimus dorsi.	....(?)	....(?)	
Coletti	Riforma Med. Napoli, 1906, XXII, 290.	5	F.	Congenital.	Trapezius.	Excision.	Recovery.	Cavernous angioma, also subcutaneous angioma of arm. No pain. Skin normal.
H. Coote	London Med. Gaz. 1852, p. 412.	(?)	F.	Congenital.	Deltoid.	....do.	....do.	Simple venous angioma.
Corneloup	Lyon Méd. 1904, CII, 909.	38	M.	Post-traumatic 20 yrs.	Vastus internus.	....do.	....do.	Cavernous angioma. Diffuse. No pain.
Cruveilhier	Cit. by Coletti.	(?)	F.	....(?)	Biceps, coracobrachialis, brachialis anticus, pectoralis, major.	....(?)	....(?)	Cavernous angioma. Found at autopsy.
Delegenière	Cit. by Alessandri.	(?)	(?)	....(?)	Flexors of forearm.	....(?)	....(?)	
Demarquay	Union Médicale 1861.	28	F.	9 yrs.	Supinator longus.	Excision.	Recovery.	Cavernous angioma. Pain. Encapsulated. Unable to extend arm. Diagnosed neuroma of radial.
Do.	.....do.....	(?)	(?)	....(?)	Flexor sublimis and profundus digitorum.	....do.	....do.	Erectile tissue.
Do.	Dictionnaire Dechambre. Cit. by Sutter.	29	M.	....(?)	Semimembranosus.	....do.	....do.	
Denonvilliers	Union Médicale 1861.	(?)	(?)	....(?)	Rectus femoris.	....(?)	....(?)	Cavernous angioma.
Donati	Archivo per le Scienze Med. Vol. XXX, No. 26, p. 502.	25	F.	3-4 yrs.	Soleus.	Excision.	Recovery.	Cavernous angioma. Diffuse. Pain. Loss of function of leg.
Eve	Brit. Med. Jour., 1901, No. I, 1143.	15	F.	4 yrs.	Vastus internus and synovial membrane of knee-joint.	....do.	....do.	Cavernous angioma. Pain. Swelling.

Author.	Reference.	Age.	Sex.	Duration.	Location.	Treatment.	Result.	Remarks.
Eve	Brit. Med. Jour., 1901, No. I, 1143.	Young	F.	...(?)	Knee-joint and surrounding muscles.	Excision.	Recovery.	Cavernous angioma. Diffuse.
Do.	do.	24	M.	3 mos.	Triceps, anconeus, and synovial membrane.	....do.	....do.	Angioma with much fat.
Do. (Discussion).	Cit. by Kolaczek.	(?)	(?)	....(?)	Gracilis.	....do.	....do.	Muscle angioma.
Do. Discussion).	do	(?)	(?)	....(?)	Flexors of forearm.	....do.	....do.	Muscle angioma.
Fritsche	Cit. by Sutter.	9	F.	Post-traumatic $1\frac{1}{2}$ yrs.	Semimembranosus and tendinosus.	...do.	....do.	Cavernous angioma. Size of small pumpkin. Encapsulated. No pain. Diagnosed abscess.
Fonari	Raccoglita Med. Forli, 1894, IV. s. XXI., 433.	12	M.	Congenital.	Sartorius.	....do.	....do.	Cavernous angioma. Speaks of afferent artery.
Furlkröger	Cit. by Kolaczek.	23	M.	Congenital.	Short muscles sole of foot.	....do.	....do.	Diffuse cavernous angioma.
Germe	Thèse de Paris, 1900, Case of Tilloux.	20	F.	Congenital 18 yrs.	Teres major.	....do.	....do.	Cavernous angioma. Pain.
Do.	Thèse de Paris, 1900, Case of Reclus.	35	M.	Post-traumatic 16 yrs.	Latissimus dorsi, teres major.	....do.	....do	Cavernous angioma. Lately pain and rapid growth. Diagnosed sarcoma-hematode.
Gross	System of Surgery, Vol. I., 617.	(?)	F.	... (?)	Deltoid.	...do.	....do.	
Gussenbauer	Cit. by Alessandri.	(?)	(?)	....(?)	Quadriceps extensor.	....(?)	....(?)	
Do.	do.	(?)	(?)	....(?)	Abdominal muscles.	....(?)	....(?)	
Do.	do.	(?)	(?)	....(?)	Quadriceps extensor.	....(?)	....(?)	
Hardouin	Bull. et Mém. Soc. Anat. de Paris, 1905, LXXX, 261.	23	M.	$3\frac{1}{2}$ yrs.	Quadriceps femoris.	Excision.	Recovery.	Cavernous angioma. Diffuse. Pain. Healed by granulation. Diagnosed tuberculosis.
Heide	Arch. f. klin. Chir. Vol. LXXX, part 3.	12	M.	Congenital.	Lower extremity.	Electrolysis.	Improvement.	Cavernous angioma. Diffuse. Compressible. Phleboliths. Skin involved.
Heinlein	System of Pract. Surg. von Bergman, Vol. III, 145.	(?)	(?)	.. .(?)	Upper arm.	Excision.	Recovery.	Cavernous angioma. Subfascial, intermuscular. The size of a goose egg.
Henoque	Cit. by Coletti.	(?)	(?)	....(?)	Soleus.	....(?)	....(?)	
Honsell	Beiträge zur klin. Chir. 1902 No. 32, p. 259.	21	F.	6 yrs.	Entire biceps femoris, semimembranosus and tendinosus.	Partial excision.	Recovery.	Cavernous angioma. Two lobes. Pain.
Hulke	Cit. by Alessandri.	(?)	(?)	....(?)	Trapezius.	....(?)	....(?)	
Karewski	Cit. by Alessandri.	(?)	(?)	....(?)	Deep neck muscles.	....(?)	....(?)	
Do.	do.	(?)	do.	....do.	Trapezius.	....(?)	....(?)	
Keen	Annals of Surg. 1905, II, p. 393.	12	M.	Post-traumatic 7 yrs.	Extensor brevis pollicis, flexor longus pollicis (foot).	Excision.	Recovery.	Cavernous angioma. Pain.
Keller	Deutsche Zeitsch. für Chir. 1904, LXXIV, p. 574.	24	F.	Congenital.	Biceps femoris, semimembranosus.	....do.	....do.	Cavernous angioma. Loss of function. Pain. Post-operative infection.
Do.	do.	20	F.	....(?)	Deep back muscles.	....do.	....do.	Cavernous angioma. Phleboliths.
Kirmisson	Bull. et Mém. Soc. de Chir. de Paris, 1905, XXXI, p. 19.	14	F.	....(?)	Crural triceps.	....do.	....do.	Cavernous calcified angioma. Pain. X-Ray in diagnosis of.
Kolaczek	Beiträge z. Klin. Chir. Vol. LVI, 2, p. 448.	13	F.	3 yrs.	Biceps brachii.	....do.	....do.	Cavernous angioma. Encapsulated. Pain. Bony spicule.
Do.	do.	16	M.	3 mos.	Biceps femoris.	....do.	...do.	Simple angioma. Diffuse. Pain.
Do.	do.	47	F.	7 mos.	Rhomboideus.	....do.	....do.	Cavernous angioma. Pain.
Do.	do.	21	M.	5 yrs.	Masseter.	....do.	....do.	Cavernous angioma. Pain. Somewhat circumscribed.
Do.	do.	23	F.	9 yrs.	Biceps femoris, vastus externus, gastrocnemius and soleus.	....do.	....do.	Cavernous angioma. Diffuse. Skin involved. Enlarged superficial veins. Pain. Phleboliths.
Lebert	Traité d'Anatom. Path. General et Special, 1857, I, 210.	(?)	(?)	...(?)	Triceps (arm).	....do.	...do.	Capillary and cavernous angioma.
Le Dentu	Études de Clin. Chir., Par. 1895.	9	F.	....(?)	Soleus.	....do.	....do.	Cavernous angioma. Compression of posterior tibial nerve. Pain. Diagnosed neuroma.
Lichtenaur	Cit. by Kolaczek.	(?)	M.	....(?)	Semimembranosus, gastrocnemius.	....do.	....do.	Multiple primary muscle angioma.
Liston	Med. Chir. Trans. Vol. XXVI, 1823.	10	M.	Congenital 8 yrs.	Semimembranosus.	....do.	...do.	Cavernous angioma. Circumscribed. Pulsation in early stage. Pain.
Do.	do.	40	M.	4 yrs.	Sterno-cleido-mastoid.	....do.	....do.	Erectile. Size of turnip.

Author.	Reference.	Age.	Sex.	Duration.	Location.	Treatment.	Result.	Remarks.
Lucke.....	Cit. by Alessandri.	(?)	(?)	....(?)	Trapezius.	....(?)	....(?)	
Magon	Bull. Soc. Anat. 1875.	(?)	(?)	....(?)	Superficial flexors (forearm).	Excision.	Recovery.	Cavernous angioma. Completely reducible. Pain. Phleboliths.
Mahar.....	Bull. et Mém. Soc. Anat. de Paris, 1904, LXXXI.	42	F.	10 yrs.	Pronator quadratus.	....do.	....do.	Cavernous angioma. Pain. Formication and numbness. Diagnosed bone tumor by X-Ray. Phleboliths.
Maisonneuve.	Union Méd. 1861.	(?)	(?)	....(?)	Deep neck muscles.	... (?)	. (?)	
Margarucci...	Anno. Per. I, LXXV, v. Insegn. Chir. di F. Durante. Univ. di Roma, 1898, III, 351.	26	M.	Post-traumatic.	Gastrocnemius.	Excision.	Recovery.	Cavernous angioma. Centres of ossification.
Do.....	Cit. by Alessandri.	20	M.	....(?)	Rectus abdominis.	....do.	....do.	Cavernousangioma. Compressible.
Mazzoni.....	Cit. by Alessandri.	(?)	(?)	....(?)	Triceps brachialis.	...(?)	....(?)	
Mendelsson...	Cit. by Kolaczek.	2	M.	Congenital.	Triceps brachii.	Excision.	Recovery.	Cavernous angioma.
Meyer.....	Inaug. Dissert. Berlin, 1898, Cit.by Alessandri.	19	M.	Sometime.	Triceps brachialis.	....do.	....do.	Cavernous angioma. Diffuse.
Do.....	.....do.	33	F.	Congenital.	Flexors of the forearm.	....do.	....do.	Spongy tumor. Diffuse. Phlebolith.
Monzardo.....	Riv. Veneta de Sc. Med. Venezia, 1903, p. 542.	18	F.	Congenital.	Quadriceps femoris.	....do.	....do.	Cavernous angioma. Diffuse. Slight pain. Lymph lacunae present in some places.
C. de Morgan.	Brit. and For. Med. Review, 1864.	10	F.	Congenital.	Gastrocnemius.	....do.	.... (?).....	Cavernous angioma. Pain.
Do.....	.....do.	Mid. age.	F.	..(?)	Rectus femoris.	....do.	....(?).....	Cavernous angioma. Circumscribed.
Muscatello....	Riv. Veneta de Sc. Med. Venezia, 1894, XX.	9	F.	A few mos.	Trapezius.	....do.	....(?).....	Simple capillary angioma. Diffuse. Many new formed vessels. Karyokinesis in endothelial cells.
Do.....	.....do.	18	F.	Congenital.	Quadriceps femoris.	....do.	....do.	Arterial angioma.
Do.....	..... do.	28	M.	5 yrs.	Serratus magnus.	....do.	....do.	Cavernous angioma. Phleboliths.
Nagatomi.....	Mitt. de. Med.Gesellsch. zu Tokio, 1905, XIX. 1055.	27	M.	5 yrs.	Gastrocnemius.	....do.	.. .do.	Cavernous and venous angioma. Diffuse. Pain. Partially reducible. Skin normal.
Do..... ..	Do. (Case of Miyaki.)	9	F.	3 yrs.	Gastrocnemius.	....do.	....do.	Cavernous angioma. Diffuse. Pain. Pes equinus. Nerve trunks involved. Diagnosed gumma, then neuroma, then angioma.
Do.....	Do. (Case of Matsuaka).	40	M.	1 yr.	Gluteal muscles.	....do.	....do.	Cavernous angioma. Diffuse. Pain. Pulsation, (late stage). Compressible.
Do..	Do. (Case of Murata).	23	M.	3 yrs.	Sacro-lumbar muscles.	... do.	....do.	Cavernous angioma. Diffuse. Pain. Size of child's head.
Do.....	Do. (Case of Hida).	(?)	(?)	....(?)		....do.	... do.	Cavernous angioma. Diffuse. Vein stone.
Do.....	Mitt. d. Med. Gesellsch. zu Tokio, 1906, 373.	9	M.	Congenital.	Masseter.	....do.	....do.	Cavernous angioma. Pain. Not compressible. Present at birth. Disappeared and returned 6 years ago.
Nast-Kolb....	Beiträge zur klin. Chir. No. 55, 542.	12	F.	9½ yrs.	Leg muscles.	Amputation.	....do.	Cavernous angioma. Diffuse. Pain. Not compressible. Pes equinus. Enlarged veins. Posterior tibial nerve involved.
Nelaton and Tillaux.	Bull. Soc. Anat. 1861, p. 10.	Young	F.	....(?)	Pronator radii teres.	....(?)	....(?).....	
Ollier	Cit. by Rigaud.	(?)	(?)	....(?)	Pectoralis major.	....(?)	....(?).....	
Pantaleoni ...	Bull. delle Sc. Med. Chir. di Bologna, 1904, s. 8, IV, 442.	25	F.	11 yrs.	Masseter muscle.	Excision.	Recovery.	Cavernous angioma. No pain. Diagnosed tuberculous gland.
Do.....	Cit. by Kolaczek.	8	F.	3 yrs.	Masseter.	....do.	....do.	Primary muscle angioma.
Pean.....	Leçons de Clin. Chir. Paris, 1876, p. 544.	21	(?)	2 yrs.	Masseter.	....do.	...do.	Cavernous angioma. No pain. circumscribed.
Petersen.....	Inaug. dis. Kiel, 1894.	11	F.	4 yrs.	Quadriceps extensor.	....do.	....do.	Cavernous angioma. Phleboliths.
Do...	.....do.	7	M.	5 yrs.	Calf muscles.	...do.	....do.	Cavernous angioma. Diffuse.
Pilzer.	Virchow's Archiv. No. 165, p. 427.	14	M.	.. .(?)	Muscles of leg and thigh.	Partial excision.	....do.	Cavernous angioma. Diffuse. Pain. Nerve trunk involved. Tiersch graft.
Pupovac.....	Archiv. f. klin. Chir. 1897, No. 54, 555.	15	M.	5 yrs.	Thigh muscles.	Excision.	....do.	Cavernous angioma.
Pupovac.....	.....do.	14	F.	6 yrs.	Quadriceps femoris.	....do.	....do.	Cavernous angioma.
Do....	.....do.	17	F.	Congenital.	Abdominal muscles.	....do.	....do.	Cavernous angioma.

Author.	Reference.	Age.	Sex.	Duration.	Location.	Treatment.	Result.	Remarks.
Putti.....	Archiv f. klin. Chir. No. 79, 1906, p. 1031.	33	M.	....(?)	Gastrocnemius.	Excision.	Recovery.	Cavernous angioma. Pain. Deformity (equinovarus). Diagnosed neuro-fibroma.
Do.....	... . ..do.	29	M.	Post-traumatic, 19 yrs.	Gluteus maximus.	....do.	....do.	Cavernous angioma. Pain. Varicose veins. Pes equinus.
Quenu	Cit. by Alessandri.	(?)	(?)	....(?)	Pectoralis major.	....(?)	....(?)	
Reboul.....	Congres. Assoc. Franc. St. Etienne, 1897.	(?)	(?)	....(?)	Thenar eminence.	....(?)	....(?)	
Reclus and Magitot.	Rev. d. Chir. 1906, XXX, p. 709.	17	F.	Congenital.	Shoulder muscles.	Excision.	Recovery.	Cavernous angioma. Pain. Diagnosed sarcoma.
Do.....	... .do.	28	F.	3 yrs.	Epitrochlear muscles.	....do.	....do.	Cavernous angioma. Pain. Phlebolith.
Richet.....	Cit. by Alessandri.	(?)	(?)	....(?)	Triceps brachialis.	....do.	....(?)	Cavernous angioma.
Riethus.....	Beiträge zur klin. Chir., 1904, No. 42, p. 454.	14	F.	Post-traumatic, 4 yrs.	Tibialis posticus, flexor longus digitorum, flexor longus hallucis, plantaris.	Partial excision.	No improvement.	Cavernous angioma. Diffuse. Pain. Posterior tibial nerve involved. Amputation, 8 mos. later.
Do.....	.....do.	32	M.	8 yrs.	Sacro-spinal muscles.	Excision.	Recovery.	Cavernous angioma. Pain.
Rigaud.....	Thèse de Paris 1903.	45	F.	....(?)	Tongue muscles.	....do.	....do.	Cavernous angioma. Compressible.
Do.....	.....do.	(?)	(?)	....(?)	Muscles of forearm.	...do.	....do.	Cavernous angioma.
Do.	.....do.	(?)	(?)	....(?)	Dorsal muscles.	....do.	....do.	Cavernous angioma.
Ritschl.....	Beiträge zur klin. Chir., 1895, No. 15, p. 99.	(?)	(?	....(?)	Flexors of forearm.	....(?)	....(?)	
Do.....	.....do.	(?)	(?)	....(?)	Vastus internus.	...(?)	...(?)	
Roberts.....	Cit. by Kolaczek.	17	F.	....(?)	Quadriceps.	Excision.	Recovery.	Cavernous angioma.
Robin.....	Gaz. Méd. de Paris. 1854, p. 348.	(?)	(?)	....(?)	Vastus internus.	....do.	....do.	Cavernous angioma.
Rocher and Lafon.	Journal de Médicine de Bordeaux, Jan. '07, XXXVII, p. 42.	52	M.	Post-traumatic, 32 yrs.	Orbicular muscle of eye.	....do.	....do.	Cavernous angioma. Circumscribed. Pain. Diagnosed dermoid cyst.
Rosciano.....	Klin. Chir. Milano, 1904, p. 900.	22	M.	Congenital.	Rectus abdominis.	....do.	...do.	Cavernous angioma. Diagnosed lipoma.
Senn	Path. and Surg. Treat. of Tumors, 1900, p. 463.	16	M.	Post-traumatic, 5 yrs.	Quadriceps femoris.	....do.	....do.	Disappeared with elevation of limb.
Shaw.....	Cit. by de Morgan.	17	F.	Congenital.	Latissimus dorsi serratus magnus.	....do.	....do.	Cavernous angioma. Circumscribed. No pain.
Steele.....	Brit. Med. Jour., 1898, p. 432.	4	M.	Congenital.	Quadriceps femoris.	.. do.	....do.	Cavernous angioma.
Stonham.....	Bland Sutton's Tumors, 4th Ed.	(?)	(?)	....(?)	Gracilis	....do.	....do.	Cavernous angioma.
Strauch.....	Deutsche Zeitsch. f. Chir., 1902, No. 62, p. 323.	19	M.	15 yrs.	Masseter muscle.	....do.	... do.	Cavernous angioma. Slight pain.
Summers	Surg. Gynec. and Obstet. Chicago, 1906, II, 306.	33	M.	Post-traumatic, 8 yrs.	Gluteus maximus.	....do.	....do.	Cavernous angioma. No pain.
Sutter.....	Deutsche Zeitsch. f. Chir., 1905, No. 77, p. 368. Case of Policlinic at Berne.	2½	M.	Congenital.	Thenar muscles.	....do.	Recurrence later.	Simple angioma. Recovery after second operation.
Do.....	Do. (Case of de Quervain).	20	F.	11 yrs.	Soleus.	....do.	Recovery.	Cavernous angioma. Diffuse. Pain.
Do.....	Do. (Case of de Quervain).	12	M.	3 yrs.	Vastus internus.	....do.	....do.	Cavernous angioma. Diffuse.
Do.....	Do. (Case of de Quervain).	28	M.	Congenital.	Supinator longus.	...do.	....do.	Cavernous angioma. Pain. Limitation of motion.
Tédenat and Fuster.	Cit. by Kolaczek.	(?)	(?)	....(?)	Deltoid.	....do.	...do.	Primary muscle angioma.
Do.....	.....do.	(?)	(?)	....(?)	Biceps.	....do.	....do.	Primary muscle angioma.
Do.....	.....do.	(?)	(?)	... (?)	Quadriceps.	... do.	...do.	Primary muscle angioma.
Teevan.....	Brit. and For. Med. Chir. Rev. Vol. XXXII, p. 509.	17	F.	... (?)	Semimembranosus.	....do.	....do.	Erectile.
Thorne.....	Occident. Med. Times, San F., 1903, Vol. XVIII.	22	M.	Several mos.	Latissimus dorsi serratus magnus.	...do.	....do.	Cavernous angioma. No pain.
Tillaux.....	Cit. by Rigaud.	12	F.	....(?)	Superficial flexors of forearm.	....do.	....do.	Cavernous angioma. Burning, tingling, etc. Phleboliths. Median nerve involved.
Tricomi.....	Cit. by Coletti.	(?)	(?)	....(?)	Sterno-cleido-mastoid.	...(?)	....(?)	
Tusini.....	Archivo per le Scienze Mediche XX, 1896.	(?)	(?)	....(?)	Serrati muscles of back.	Excision.	Recovery.	Arterio-capillary angioma. (Rabdomio-angioma).

Author.	Reference.	Age.	Sex.	Duration.	Location.	Treatment.	Result.	Remarks.
Van der Spil..	Cit. by Alessandri.	(?)	(?)	....(?)	Masseter.	Excision.	Recovery.	
Vautrin.....	Cit. by Rigaud.	(?)	(?)	....(?)	Quadriceps femoris.	....do.	....do.	
Viannay.....	Provence Méd. Aug. 30, 1902.	26	F.	About 9 yrs.	Vastus internus.	Excision. Recurrence.	....do.	Cavernous angioma. Pain. Phleboliths. Excised 1898. Recurrence. Unable to extend leg. Not circumscribed. Excision 1902.
Vincent.....	Lyon Méd. 1877.	12	M.	2 yrs.	Pectoralis major.	Excision.	....do.	Cavernous angioma. Circumscribed.
Virchow	Krankhafte Geschwülste, III, p. 306.	(?)	(?)	....(?)	Thenar eminence.	...do.	... do.	Cavernous angioma.
Volkmann....	Dictionnaire Dechambre, XI, p. 117.	(?)	(?)	....(?)	Flexor profundus digitorum.	....(?)	....(?)	
Warneck.....	Centralblatt f. Chir., 1896, CLXXXIII.	28	F.	12 yrs.	Rectus abdominus.	Excision.	Recovery.	Simple angioma. Pain. Diagnosed fibro-sarcoma.
Case I..... ...	Dr. Halsted's Clinic Johns Hopkins Hosp.	18	M.	3½ yrs.	Vastus internus.	....do.	....do.	Operated on one year ago outside the Hospital. Recurrence. Cavernous angioma. Slight pain. Circumscribed. Blood cyst. Diagnosis benign tumor.
Case II.....	.....do.	25	F.	14 yrs.	Gastrocnemius, soleus.	Partial excision.	....do.	Cavernous angioma. Pain. Deformity. (Talipes equinus). Diffuse. Diagnosed chronic myositis.
Case III.	.....do.	17	M.	Post-traumatic, 10 yrs.	Flexor sublimis digitorum, flexor profundus digitorum, and intermuscular tissue.	....do.	....do.	Venous angioma. Diffuse. Pain. Phlebolith.
Case IV.....	.....do.	5	M.	Congenital.	External and internal obliquis abdominis.	Excision.	....do.....	Cavernous angioma. Diffuse. Pain. Phleboliths. Somewhat compressible.
Case V.....	.....do.	23	M.	Post-traumatic, 18 yrs.	Masseter, buccinator.	....do.	....do.	Cavernous angioma. Diffuse. Pain. Phleboliths. Somewhat compressible.
Case VI.....	Robert Garrett Children's Hosp., Balto., Md.	12	F.	Congenital.	Tibialis anticus, extensor proprius hallucis, extensor longus digitorum, peroneus tertius.	Explored.	Improved.	Venous angioma. Diffuse. No pain. Discovered during operation for excision of varicose veins of leg.

encapsulated tumors are not apt to spread, and give a better prognosis than the diffuse. There is no instance on record where an encapsulated angioma has become diffuse. The prognosis as to life is excellent.

Treatment.—Local applications, the insertion of setons, magnesium darts, and ivory pegs have been tried with little success. Various irritating and coagulating fluids, such as boiling water, nitric acid, alcohol, tannic acid, perchloride of iron in different strengths, tincture of iodine, aromatic ammonia, lead acetate, chloride of lime, and many other substances have been injected, hoping to produce scar tissue eventually, and in this way block out the tumor, but with no success in the majority of cases; while in some, abscess, slough, and even death has followed the injections. Electrolysis has proved futile in most cases, but Heide reports a case treated by electrolysis, giving satisfactory results. He used a current of 30 to 40 milliampères for 3 or 4 minutes at each sitting over a considerable period of time. Ignipuncture with the Paquelin cautery has been a trifle more successful, but the only method of treatment promising permanent cure is excision, or at least partial excision. Simple exploratory incision and inducing the formation of scar tissue will sometimes improve the condition (Case VI). If the tumor is superficial, circumscribed, and feebly adherent to the muscle then exicision is easy. If, however, it is diffuse and very deep in the substance of the muscle, excision is exceedingly difficult, and large portions, if not all, of the muscle or group of muscles involved must be removed. Hemorrhage is sometimes profuse and hard to control, and it may be necessary to tie the peripheral vessels. If this does not stop the bleeding and none of the other means at hand are effectual then it may necessitate amputation. Riethus amputated the leg in a case of diffuse cavernous angioma, with recurrence 8 months after first operation, when partial excision was done. Nast-Kolb amputated the leg in a case of cavernous angioma without previous partial excision. These are the only cases reported, and it might have been wise to attempt further partial excisions before resorting to this radical procedure.

The tabulated list above is compiled from all the cases reported up to the present time, and while it is incomplete in many of its details, it gives us some interesting information. Although the tumor was specified as congenital only 25 times, there seems to be no doubt but that it is congenital in the great majority of cases. In 12 instances there is a definite post-traumatic history. There was little choice as to sex—male 50, female 53. Duration before operation 3 months to 32 years. Youngest at time of operation 2 years. Oldest at time of operation 52 years. The tumor was simple, 14; cavernous, 98; mixed, 13; circumscribed, 15; diffuse, 31 times; the diffuse variety, however, probably being much more common than these figures show.

Pain is really the most constant symptom, and was emphasized in 51 cases. Notes on compressibility and change in size on changing position are meager. Deformity in 8; phleboliths in 17; nerve trunks involved in 7; bony formation in 5; treatment by excision complete or partial, 119; ampu-

tation, 2; recurrences, 3. The lower extremity was involved in 62 cases; the upper in 42; trunk in 30; face, 13; and neck, 4. The individual muscles or groups of muscles most frequently involved are quadriceps femoris, 27; forearm, 13; trapezius, gastrocnemius and triceps, 8 each; masseter, 7; latissimus dorsi, semimembranosus, sacrolumbar, and calf muscles, 7 each; pectoralis major and gluteii, 5 each; deltoid, 4; semitendinosus, and thumb muscles, 3 each.

Conclusions.—Primary angioma of muscle is no longer a very rare condition as the 153 cases reviewed in this paper indicate. It is a slow growing tumor, usually congenital in origin, but without doubt follows trauma in some instances. It may occur in any striated muscle, and the muscle in which it forms, plays a perfectly passive rôle. Compressibility, change in size on raising or lowering the limb, and pain are the three typical symptoms, although any one or all of them may be lacking. The clinical diagnosis is very difficult when the typical symptoms are indefinite, and many cases are not correctly diagnosed until operated upon. The skin is usually normal; the tumor is as a rule soft, but may be hard, smooth or lobulated, movable or fixed, circumscribed or diffuse. It varies in size from a small nut to a child's head. The X-ray may give some assistance in diagnosis when bony formation is present. There are two principal varieties—the simple, which is comparatively rare, and the cavernous, the latter being the most common; however, both varieties may be present in the same tumor. On section the characteristic appearance of a blood-filled sponge, brownish-red in color is seen. There is no particular afferent or efferent vessel. Microscopically the typical picture is that of blood spaces lined with endothelium, containing normal blood, and surrounded by walls of smooth muscle and connective tissue.

Phleboliths are often present in the blood spaces as well as in the dilated veins, and are thrombotic in origin. The only treatment of particular value is excision, and if complete, it is practically sure to cure the condition; however, partial excision has in a number of cases proved equally efficient, although 3 recurrences are on record following partial excision.

The *prognosis* is excellent.

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PULMONARY COMPLICATIONS FOLLOWING ANÆSTHESIA.

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In the Gynecological Service of the Johns Hopkins Hospital prior to August, 1903, about 9000 patients had been anæsthetized and of these 29 developed pneumonia soon after; six, or 21 per cent, of them died. Twenty-four cases developed the disease during the first 8 days following the use of the anæsthetic; in but one of the 5 cases which developed later did the anæsthetic seem to be a cause of the disease. Of the 29 cases, 12 were diagnosed as the lobar type of pneumonia and 17 the bronchial type. This percentage of lobar to bronchial pneumonia is rather low for nearly all the statistics show 75 to 90 per cent of the post-anæsthetic pneumonias are of the lobular type. All of these pneumonias save one followed the use of the following anæsthetics: chloroform alone, chloroform and ether, ether alone, nitrous oxide and ether, cocaine and gas (one case).

Among these 29 cases there was in 5 no report as to pre-operative lung condition; in 5 others prolonged expiration or a few scattered râles were found; in the others physical examination gave only normal findings.

The duration of the anæsthesia plays considerable part in the production of pulmonary complications, for in this series there were only 4 cases which were anæsthetized for 1 hour or less and 11 of the 29 cases took the anæsthetic for 2 hours or more. Ether early is a stimulant to the circulatory apparatus, later it loses this action, while chloroform acts as a depressant from the start—this combined with prolonged loss of bodily heat and long-continued irritation of the lung tissue would tend to aid materially in the production of post-operative complications.

Wound healing was not affected by the development of pneumonia, and this is in accord with the general view of writers on this subject.

Odd features in this series were that one patient, after examination under ether, developed pneumonia from which she recovered completely, and was later operated on a second time under ether without further lung complication. Another, that two patients operated upon recovered without pulmonary lesions, but later both had a second operation and developed pneumonia.

Cocaine.—The statistics from many of the foreign clinics where cocaine is used as a local anæsthetic (in this I do not refer to spinal anæsthesia) show a surprisingly high percentage of lung complications, especially pneumonia, a higher percentage than follows anæsthesia by inhalation. To me the most reasonable explanation is that offered by Dr. J. F. Mitchell of Washington, formerly Resident Surgeon at the Johns Hopkins Hospital, that many of these operations were done in the upper abdomen and these patients were kept flat on their backs for many days following the operative procedure. Now the tendency is to put these cases in a semi-sitting position from the start, and to get them out of bed as early as possible. Quoting from a personal letter from Dr. Mitchell regarding the prevalence of pulmonary complications following anæsthesia: "50 of my hospital operations last year were done under local anæsthesia and I have yet to see a case of pneumonia following the use of this method."

Statistics.—Here are presented reports from a few representative clinics. I would refer those desiring a complete review of the foreign literature and statistics up to the end of the year 1906, to the article by Bibergeil.

Author.	Operations.	Cases of Pneumonia.	Morbidity per-centage.	Deaths.	Mortality per-centage.
Bloodgood[1]	459 hernias	7	1.5	3	42
Mikulicz[2]	1,881	45	2.2	24	53
Czerny[3]	1,302	52	4.		
Johns Hopkins Hospital (Gyn. service) ..	9,000 anæs.	29	.3	6	21
Derjushinsk[4]	4,946	43	.9		
Magaw[5] (Rochester, Minn.)	14,000 anæs.	No deaths directly due to anæsthesia.			
Bibergeil[6] (Berlin)	3,909	135	3.4	38	28

Other complications met with: 12 lung emboli, 9 lung infarcts, 82 febrile bronchitides, 12 lung abscesses, 19 pleurisies, 13 empyemas.

Lobar Pneumonia.—Lobar pneumonia following anæsthesia apparently differs from lobar pneumonia seen in the medical wards in:

1. Temperature, which is lower and rarely reaches 103°; the curve is more irregular and not so steady as in the typical case.

2. Duration usually shorter and rarely a true crisis.

3. Greater freedom from complications (empyema).

4. Central type of pneumonia, lung signs developing late. At first râles, with slight dullness, fever, and quickened pulse. About the time temperature begins to fall or a day or so before, dullness becomes more marked and there is definite bronchial breathing.

5. Cough not marked or severe and sputum rarely blood-tinged.

The second or third day after the operation is the common time for the development of symptoms, which are those typical

[1] Johns Hopkins Hospital Reports, Vol. VII, part 5.

[2] Centralbl. f. Chir., 1897, Vol. XXVI; Archiv f. klin. Chir., Bd. LVII, Hft. 2.

[3] (Quoted from 6.)

[4] Centralbl. f. Chir., 1903, No. 25.

[5] Surgery, Gynecology, and Obstetrics, 1906, III, 795.

[6] Archiv f. klin. Chir., Bd. LXXVIII.

of pneumonia; chill, pain in the side, cough, and fever. The right lung was most often involved, the lower and upper lobes were about equally affected. The mortality in these 12 cases was 4, or 33 per cent, about the same ratio that the accepted statistics show for lobar pneumonia due to the pneumococcus. No cases of empyema or abscess of the lung developed.

Bronchopneumonia.—Hypostatic pneumonia is separated by some authors from lobar pneumonia, in being chiefly characterized by a development of small patches of pneumonia at the bases of the lungs in elderly people and in patients seriously weakened by disease where such causes as aspiration, irritation of the mucous membranes by the anæsthetic, shock, etc., could be largely excluded. They will be considered here together.

There were 17 cases with 2 deaths, 12 per cent mortality. This lesion generally appeared from 1 to 3 days after operation, ushered in by a chill and rise of temperature, which was higher in the evening and did not follow the usual curve of temperature in lobar pneumonia; cough was not a marked feature. Physical signs were mucous râles throughout the chest, especially in the lower lobes; small areas of lung tissue, with blowing breath sounds, in which partial or complete dullness was brought out by percussion; at times this dullness did not appear until shortly before the temperature began to drop. Cyanosis and very rapid respiration were rarely noticed. In the cases terminating in recovery the disease lasted from 7 to 12 days.

Bronchitis.—Thirty cases, no deaths. By this is meant a condition characterized by a feeling of tightness in the chest, slight fever, and squeaking or mucous râles mainly found at the bases of the lungs with no dullness on percussion. These cases were at no time seriously ill, and the signs and symptoms cleared up promptly without retarding convalescence.

Pleurisy.—A true fibrinous or serous pleurisy unassociated with pneumonia is one of the rarer complications of anæsthesia. Only a small number of the patients developing pneumonia had the characteristic creaking or grating sounds diagnostic of pleural involvement. The few cases of fibrinous pleurisy that did occur had the typical symptoms: sharp stabbing pain in the side, dry painful cough, and moderate fever. These symptoms disappeared after a few days and did not retard the healing of the wound. A smaller, but unknown percentage of these patients developed an effusion as shown by irregular temperature, flatness on percussion, and absence of breath sounds. These signs cleared up rapidly, and in no case was thoracentesis necessary. Pleurisy developed in nearly every case within the first 48 hours, but caused no deaths. Whether small emboli are the cause of these pleurisies by forming infarcts is impossible to say, though many writers claim this to be the main factor in their production.

Causation.—Many theories have been offered as to the etiology of post-operative lung complications, but it would seem as if in each case more than one of these theories is necessary to explain their origin.

1. Irritant action of anæsthetic.
2. Aspiration of mucus and vomitus and hypersecretion of mucus.
3. Emboli.
4. Toxic effect of anæsthetic on heart and blood-vessels.
5. Presence of pneumococci and other bacteria in mouth and throat.
6. Extension of infection through subdiaphragmatic space.
7. Cooling of the body.
8. Limitation of lung expansion.
9. Lessened resistance of patient.

1. *Irritant action of anæsthetic.*—Ether of all anæsthetics used has the most irritant effect on the mucous membrane of the bronchi and the alveolar cells. This action is direct and seems to depend almost wholly upon the percentage of ether in the air inspired during anæsthetization, for since the use of the open-drop method and the greater daring in its administration, the frequency of pulmonary complications following the use of ether has been greatly diminished. Next rank ethyl bromide and ethyl chloride, which have nearly the same effect, though now used only rarely, and principally as a preliminary to ether. Chloroform is not thought to irritate the lining membrane of the bronchi.

2. *Aspiration of mucus and vomitus and hypersecretion of mucus.*—Ether by its irritant and stimulant action causes often hypersecretion of mucus and with this there is constant danger that some portion of this mucus may pass down and enter the bronchi and fill up some of the alveoli, carrying with it the pneumococcus and other organisms. This is also true of vomitus, for the aspirated stomach contents may fill many of the alveoli and by their irritant action set up inflammation. Hypersecretion of mucus at times seriously interferes with the patient receiving a small, constant supply of the anæsthetic, for the mouth must be swabbed out frequently and there are often attempts at coughing.

The value of atropin, 1/100 of a gr., given hypodermically half an hour before the anæsthetic is started, is questionable, as many clinics where this method has been tried have given it up as valueless.

3. *Emboli.*—Some authors claim that these are the most important cause through plugging of one of the smaller branches of the pulmonary arteries, with infarct formation. Unless the additional cause be added of infection of the area by pneumococci or some other organism, it would seem as if this theory were sufficient to account for partial or complete lobar consolidation. That emboli are often a factor is no doubt true, but other factors must play an assisting rôle.

4. *Toxic effect of anæsthetic on heart and bloodvessels.*—Chloroform in this respect seems to be the most dangerous of the anæsthetics used. It has a definite depressant effect on the heart and bloodvessels if given too rapidly in the early stages of anæsthesia in too great concentration. Its action may be delayed for several days, when the heart may fail, due to some slow toxic action on the muscle.

Cases of right auricular dilatation usually follow anæsthesia if this lasts an hour and a half or more, but hypostatic congestion of the lung is rarely seen in short operations, un-

less in old people with cardiac hypertrophy and sclerotic arteries.

5. *Presence of pneumococci and other bacteria in mouth and throat.*—It has been proved that from 15 to 20 per cent of healthy persons harbor the pneumococci constantly in the mouth or throat, and sometimes the streptococcus. By aspiration of mucus, these organisms can easily reach the bronchii and alveoli and there develop, if the irritant nature of the anæsthetic used has injured the lining membrane. It is possible that in septic cases the infection has been caused by the blood, the organism penetrating the wall of the alveolus which has been injured by the irritant action of the anæsthetic.

6. *Extension of infection through subdiaphragmatic space.*—An infection may spread from an abscess of the appendix, a perforated duodenal or gastric ulcer, etc., into the right subphrenic area and thence by the lymph channels under and through the diaphragm to the right pleura. On the left side the anatomical relations prevent any infection travelling upward under the diaphragm.

7. *Cooling of the body.*—A loss of temperature of ½ to 1° may follow prolonged anæsthesia, even when no other factor is concerned. The cold glass or iron work of the table on which the patient is laid; the placing of wet, sterile towels about the site of incision; the use of irrigating solutions, and the conveyance of the patient through cold halls, all tend toward cooling the body and often chill it seriously. Some of these factors can readily be eliminated from operations, and it may be said fairly that it is largely due to carelessness on the part of the surgeons if patients are chilled in such ways.

8. *Limitation of lung expansion.*—Recent writers lay great stress on this point, claiming that, especially in operations above the umbilicus, pain in the incision on deep breathing, for the first two or three days is so severe that patients endeavor to keep the abdominal muscles and diaphragm as still as possible and so limit normal respiration and the æration of the alveoli. This limitation is also influenced by meteorism; by the use of the Trendelenburg position on the operating table, and that used in operations on the kidney through the loin.

9. *Lessened resistance of the patient* through illness, anæmia, the shock of a long operation often with considerable loss of blood, slight bronchitis, and the time of year are other factors that have occasionally decided influence in the production of pulmonary complications.

Prevention.—Disinfection of the mouth and nose by mild antiseptic gargles and douches should be a routine measure.

Careful administration of the anæsthetic by the drop method on an open mask, given slowly and steadily at first so the patient is not suffocated and does not struggle is all important.

In regard to position the head should be low and to one side so that mucus can flow out easily; the jaw kept forward to keep the tongue from dropping back into the pharynx. More care should be taken to keep patients warm and dry. There should be warm pads on the table and warm jackets and leg coverings should be worn. The sterile dressings should be dry. The patient should be warmly covered up when removed from the operating table to bed.

ON THE RELATION OF THE PARATHYROID TO CALCIUM METABOLISM AND THE NATURE OF TETANY.

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Preliminary Note.

Several clinical studies of such conditions as rickets, osteomalacia, etc., have suggested the possibility that tetany might stand in some relation to disturbances in calcium metabolism and this has been further suggested by the work of Loeb and J. B. MacCallum on the effect of various salts in the production of muscular twitchings and the counteraction of these effects by calcium. Particularly striking also are the observations of Verstraeten and Vanderlinden, Halsted and others on the mild character or absence of tetany after parathyroidectomy when the animal is kept upon an abundant diet of milk which is rich in calcium.

We have, therefore, undertaken a study of the calcium metabolism of animals in which tetany is produced by parathyroidectomy and of the relations of various salts, especially those of calcium to the tetany thus produced. A later publication will give the details of this work which is not yet complete, but the results already obtained may be set down here.

All violent symptoms produced by parathyroidectomy, muscular twitching, and rigidity, tachypnœa, fibrillary tremors, increased rapidity of the heart beat, etc., may be almost instantly cured by the intravenous injection of a solution of a calcium salt. We have usually employed the acetate or lactate in 5 per cent solution. Subcutaneous injection or the

introduction of the solution into the stomach are quite as effective but act more slowly. The condition of complete well-being attained in this way lasts for perhaps 24 hours when tetany may reappear, but disappears immediately upon renewed administration of calcium. Injection of magnesium salts has a somewhat similar effect in causing the symptoms of tetany to disappear, but the results are obscured by the toxic anæsthetic action of the salt. On the other hand the injection of potassium salts in tetany not only causes no amelioration, but actually intensifies all the symptoms. Similar results are expected from other salts of this character which, as yet, have been imperfectly tested. After the tetany is thus accentuated by the injection of potassium it may be caused to disappear completely by the injection of a calcium salt. It is found necessary to use in such a case a larger amount of calcium to overcome the effect of the potassium.

Our studies of the excreta in parathyroidectomised animals on a constant diet or during starvation tend to show an increased output of calcium as compared with the control, but these observations are, so far, so incomplete, that we are unwilling as yet to make any definite statement on this point.

On the other hand the analysis of the blood taken from a dog during tetany shows a calcium content which is only about half that of the normal dog on the same constant diet. The analysis of the brain, muscles, and other tissues is in progress, and its results are looked forward to with especial interest.

It seems possible to construct at least a plausible working hypothesis to explain these results, although this can at present be only a superficial explanation. Apparently the parathyroids control in some way the calcium metabolism so that upon their removal a rapid excretion, possibly associated with inadequate absorption and assimilation deprives the tissues of calcium salts. There arises in this way a condition analogous to that described by Loeb and J. B. MacCallum who showed that muscular twitching could be produced by the introduction of salts capable of precipitating the calcium in insoluble form, and removed by the addition of fresh soluble calcium salts. In the case of tetany, however, the central nervous system seems to be especially affected as has been shown by experiments in which muscles isolated from nervous control showed no twitching during tetany.

The certainty and rapidity with which the symptoms of tetany are dispelled by the administration of calcium salts makes it seem probable that this observation will have some therapeutic importance not only in postoperative tetany, but also in the various forms of tetany which occur spontaneously in children and in connection with infectious diseases, pregnancy, lactation, etc. It seems possible that the tetany of lactation may be due to the great drain of calcium in the production of the calcium rich milk, especially in individuals in whom there is some parathyroid insufficiency, and the validity of this hypothesis is being tested.

If further study confirms the accuracy of these observations it may be possible to compare the condition with that in pancreatic diabetes in which the loss of control of the carbohydrate metabolism by the destruction of the Islands of Langerhans allows an abnormal carbohydrate excretion and tetany might accordingly in that case be spoken of as *"diabetes calcarius."*

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS MEDICAL SOCIETY.

December 2, 1907.

I. Exhibition of Cases. DR. CUSHING.

II. Exhibition of Cases. DR. WILLIAMS.

III. Effect of Changes of Blood Pressure upon the Pulse Rate. DR. EYSTER and DR. HOOKER.

The experiments described in this paper were concerned with an attempt to determine whether the decrease in pulse-rate that results from a considerable increase of arterial pressure is due to a direct action of the increased pressure upon the cardio-inhibitory center, or whether this center is stimulated through afferent nerves and the slowing thus brought about reflexly.

These experiments may be divided into groups as follows:

1. Decrease of pulse-rate from rise of pressure produced by ligation of different portions of the thoracic aorta in dogs. Occlusion of the ascending aorta (with consequent rise of intracardiac pressure) was without effect upon the pulse-rate; in fact, even an increased rate sometimes occurred. Occlusion of the transverse or descending thoracic aorta caused a decrease in pulse-rate.

2. Decrease in pulse-rate was obtained in dogs and rabbits by temporary increase of pressure confined to the thoracic aorta. The previous pulse-rate or a more rapid one occurred when the pressure was relieved.

3. Increase of pressure confined to the cerebral arteries caused also a marked slowing of the pulse.

4. When the increase of pressure was confined to the heart no definite slowing of the pulse-rate was observed.

5. When the increase of pressure was confined to the coronary arteries, the results of these experiments were not very conclusive. In some cases slowing occurred, but never to the marked degree that was obtained from increase of pressure within the aorta.

The phenomenon of decrease in pulse-rate from increase of arterial pressure in animals with intact vagi is therefore due to two factors. These are a direct effect of the increased pressure upon the cardio-inhibitory center and a reflex stimulation of this center through afferent nerves arising from the

aorta and probably not from the heart. The experiments are to be continued with the view of determining through what nerves these afferent fibers are carried to the cardio-inhibitory center.

IV. On the Excretion of Urotropin in the Bile and Pancreatic Juice. MR. CROWE.

The author reported the results of a series of experiments, made to determine the fate of urotropin in the body and its efficacy as a sterilizing agent in the bile and other secretions of the body.

It was determined by experiments on dogs that after the administration of urotropin by mouth, it was excreted both in the bile and pancreatic juice.

Hehner's test for formaldehyde was used, and by rough colorimetric comparison it was estimated to be equivalent to a 1:12,000 solution of formaldehyde. It was present in the bile contained in the gall-bladder 24 hours after giving 15 grains of urotropin by mouth.

In view of these findings, observations were made on a series of patients in the hospital who had biliary fistulæ. Bacteriological studies were made before and after giving the drug; and in every case the infecting organisms rapidly disappeared when the dose of urotropin given was 75 grains or more a day. As in the urinary bladder the organisms appear again as the dose is decreased.

The bile discharged through the fistula, when acidified and distilled, always gives the test for formaldehyde, the amount present varying with the amount of urotropin given.

In every case the patient's general condition improved, the discharged bile changed from a dirty, turbid fluid, to the golden-yellow of normal bile, and the fistulæ closed rapidly.

Urotropin was shown to be present repeatedly in the cerebrospinal fluid, even after very small doses by mouth. In one case with a badly infected cerebrospinal fistula, with sloughing and a purulent discharge, the organisms gradually disappeared after urotropin was begun, the fistula closed, and the patient made a good recovery.

Formaldehyde was shown to be present also in the pus obtained from a gonorrhœal knee-joint; but sufficient time has not as yet elapsed to report on its therapeutic effect in this case.

December 16, 1907.

DR. FINNEY presiding.

I. A Family of Hemeralopes. DR. BORDLEY.

This paper will shortly appear in the JOHNS HOPKINS HOSPITAL BULLETIN.

DISCUSSION.

DR. RANDOLPH.—The part played by heredity in bringing about certain abnormal conditions of the eye is of course an old story. Cohn reports instances where glaucoma has occurred in members of the same family through four generations. The presence of cataract in members of the same family for several generations is not an uncommon observation and we have seen not a little in literature within the past few years of the so-called "hereditary optic nerve atrophy." The cases just reported are unusually interesting. I am glad to see that Dr. Bordley adheres to the Continental interpretation or definition of the word *hemeralopia*. While I appreciate the position taken by most British and American ophthalmologists on this point, I think the reason for regarding hemeralopia as night-blindness, not day-blindness, is the better reason. As we know, almost all the standard works on ophthalmology in English nowadays refer to hemeralopia as a condition in which the individual is unable to see during the day and is only able to see by reduced illumination. Just the opposite view is taken by such writers as Fuchs, Schweigger, Meyer, and others, who hold that hemeralopia is a symptom by reason of which the person sees better by day than night, a view which I have usually held. Personally I should like to see the words hemeralopia and nyctalopia dropped and the words night-blindness and day-blindness substituted.

In answer to an inquiry by Dr. Boggs, Dr. Bordley stated that no members of this family of hemeralopes exhibited nutritional disturbances of any other organs of the body. In reply to questions by Dr. Hurd, the speaker said that the patients usually died in the seventh decade of life. Some showed senile changes rather early; one of the girls, who is about 30 years old, has an arcus senilis and markedly sclerotic arteries.

II. Exhibition of Cases. DR. RANDOLPH.

The first case which I have to present this evening is one upon which I have recently operated for cataract. It is interesting to me for two reasons, first because at the operation I was confronted with—in my experience—a unique difficulty—nystagmus. One can readily imagine the difficulties attendant upon making the corneal incision and delivering the lens from an eye which is constantly moving from side to side. About 11 years ago she was operated upon unsuccessfully for cataract in her right eye by a local ophthalmologist. She came to me soon after to see if I could help her. I found the pupil closed with a dense, organized exudate and I could offer her no encouragement so far as that eye was concerned. Since that time her left eye has been growing slowly blind and a few weeks ago she presented herself to me for operation. There was nothing remarkable about the appearance of the eye before the operation except that any effort of the eye to move outward toward the vertical plane would be accompanied with clonic spasms. I have never been quite clear as to the cause of this condition. I found considerable difficulty in making the corneal incision and more than once after entering the anterior chamber the eye was drawn inward so far as to almost free itself entirely of the knife. As a result I think of this constant movement which I could not control with fixation forceps the counterpuncture was made too high up and the opening through which the lens was to pass was too small. I was equally unsuccessful in enlarging the opening to any great extent. The

lens was dislocated into the vitreous and it was only after the most delicate sort of manipulation that I succeeded in getting it out.

I don't think I have ever sent a patient from the operating table with less hope on my part of a good result. There is hardly a mishap which is more to be dreaded than an incision too small for the passage of the lens. The opening is not easy to enlarge and when we have finished the operation we leave behind a bruised wound and the very conditions favorable to infection. The eye was irrigated freely with a warm sterile salt solution and she was put to bed. The case is interesting to me again as showing the value of cold applications in these infected wounds. A large bowl containing a block of ice was placed near her and small pads of gauze which had lain on the ice were kept on the eye constantly night and day and this was kept up for a week. Of course atropin was employed in the usual manner. I think, however, that the good result is to be attributed almost entirely to the effect of lowering local temperature and thus rendering conditions in the conjunctival sac unfavorable for the multiplication of bacteria. An ordinary bandage or even the shield would have resulted I believe in loss of the eye. As it is she has good vision.

The second case is one in which I removed a large piece of steel from the vitreous of the right eye. The foreign body had been there for nearly three weeks. It was localized by the so-called "Sweet Method." It was found to have passed little more than half way across the eye and lay in the posterior part of the vitreous. An incision was made a little below its location and it was removed with great difficulty owing to its large size and irregular borders. Not a little vitreous was lost. Cold applications were made in the same manner as in the cataract case and he has now the ability to count figures in the outer half of the field. It has always been my rule to apply cold in these cases of penetrating wounds of the eye-ball and I think it has a most important bearing upon the outcome in this class of cases. It is the first time, however, that I have used cold in the after treatment of a cataract case which after all is nothing more than a penetrating wound of the eye-ball. As I look back upon some of my unsuccessful cataract operations I recall more than one where I believe the result would have been entirely changed if I had adopted this simple measure.

III. The Practical Value of the Demonstration of Spirochæta Pallida in the Early Diagnosis of Syphilis. DR. GERAGHTY.

This paper is to be published in the JOHNS HOPKINS HOSPITAL BULLETIN.

DISCUSSION.

DR. FINNEY.—This report of Dr. Geraghty's is of very great practical importance. I know of several cases where severe surgical operations might have been avoided, had we had so definite a diagnostic method as Dr. Geraghty has described. I have encountered several cases in the past where it was utterly impossible to differentiate chancre from cancer. I think this method of Dr. Geraghty's is of tremendous value,—more perhaps to the general surgeon than to the specialist, for it is the general surgeon who is most likely to encounter cases of extra-genital chancre where the detection of the Spirochæta Pallida would be so advantageous.

January 6, 1908.

DR. FINNEY presiding.

I. Exhibition of Cases. DR. BARKER.

Dr. Barker reported two cases of cerebrospinal meningitis that had been treated by injections of Flexner's meningitis serum.

CASE I. A boy, aged 6 years, was admitted to the hospital with a history of a 6-weeks' illness. He was supposed to have had acute lobar pneumonia 6 weeks previously. Afterwards he developed a rise in temperature, headache, earache, retraction of the neck, and vomiting. On admission the boy was screaming continually, his neck was stiff, he showed Kernig's and Babinski's signs, as well as headache, and extreme sensitiveness of the skin. There was no strabismus and no opisthotonos.

A lumbar puncture was done. The intra-spinal pressure was 400 mm.; 25 cc. of fluid were removed. This fluid contained small flocculi. Cultures and smears showed diplococci intra-cellularis to be present in the fluid. At this time the boy's temperature ranged from 98.0° to 104.0°, the rise occurring in the evening. Examination of the ears revealed bulging membranes. After puncture of the membranes there was a drop in the temperature.

Four days later at another lumbar puncture the pressure was 520 mm.; 35 cc. of fluid were removed in which diplococci were again found. After this second lumbar puncture 25 cc. of serum were injected into the spinal canal. Within 12 hours the temperature fell from 102.4° to 98.0°; the boy slept soundly and felt better.

The following evening there was a rise of temperature; 20 cc. of cerebrospinal fluid were now removed and replaced by serum. At this time the pressure was 160 mm. Forty-eight hours later a fourth lumbar puncture was done when the pressure was found to be 260 mm. and 20 cc. of fluid were removed and the same amount of serum injected. The fluid was clear and contained few diplococci. At this time the temperature was normal. Several later specimens of fluid have been withdrawn, of which the last two have been sterile.

Improvement has been marked. The stiffness of the neck and headache have disappeared. In all, 65 cc. of serum has been injected. The case is interesting because of its late recognition and because the serum seems to have been beneficial where employed in a late case. Flexner thinks the serum acts best in early cases.

CASE II. A boy, aged 15 years, was admitted to the hospital on the evening of the fourth day of the disease. He had a well-defined case of meningitis. A lumbar puncture showed 400 mm. pressure; 35 cc. of a very cloudy fluid were withdrawn and 15 cc. of serum injected. Diplococci were found

in the fluid. During the transfer of fluid the patient's condition was alarming. His blood-pressure ranged from 160 to 200 mm., where it remained for 12 hours. His temperature was 103.0° to 104.0°.

The next day the boy's temperature was 100.0° and his pulse 80. He was comfortable and his squint and opisthotonos had disappeared. A second lumbar puncture showed 520 mm. pressure and 40 cc. of cloudy purulent fluid were removed in which the diplococci were hard to find; 30 cc. of serum were injected. The next day, the seventh day of the disease, 20 cc. of serum were injected after a third lumbar puncture. The patient's condition improved markedly though his neck was still stiff. His temperature fell gradually to below 100.0° to-day.

This afternoon his temperature suddenly shot up to 103.4°. A fourth lumbar puncture showed a pressure of 480 mm.; 46 cc. of cloudy fluid were removed and 25 cc. of serum injected. This elevation of temperature this afternoon looks like a relapse, though it may be due to a complicated infection. It is impossible to talk about the value of the serum from the results obtained in these two cases. Flexner reports 75 or 80 cases treated with this serum, in which the mortality has been less than the ordinary mortality of meningitis cases. The serum is probably not an antitoxic serum. It is not known exactly what it is.

DISCUSSION.

DR. RANDOLPH.—Were the eye-grounds examined in these cases?

DR. EMERSON.—Case I showed choked disc on left side. Nothing abnormal was to be made out in the second.

DR. RANDOLPH.—Accounts of epidemics are characterized by different kinds of eye symptoms. Some 10 or 12 years ago, in an epidemic in the western part of the state, the eye symptoms were localized in the back of the eye; in some epidemics they are localized in the muscles. In this epidemic they consisted in an enormous dilatation of the veins of the retina, which in some cases reached such remarkable size as to suggest the diagnosis of the case. There were no ear symptoms in this epidemic that I can recollect. In another epidemic reported from Heidelberg the changes were largely in the choroid.

II. Pancreatic Disease. DR. EMERSON.

The author thought this a subject that has not been sufficiently emphasized in the teaching and practice of clinical medicine. He prefaced his remarks by a discussion of various anatomical and physiological characteristics of the pancreas. Multiple pancreases are infrequent; there are only 14 instances reported. While there are many cases of accessory pancreases on record, there are in the literature only a very few reports of such organs possessing a proper duct. Only three cases of complete encircling of the duodenum by a pancreatic ring are on record. The pancreas normally enjoys a very central position in the body and has manifold relations; and it is therefore easy to understand why in trouble with the pancreas the other organs give the symptoms. It is in the triangle that is bounded on two sides by the duct of Wirsung and the duct of Santorini that chronic pancreatitis most often begins. We must remember in this connection that there may be a constant circulation of intestinal microorganisms through this triangle by way of the two ducts.

Cases may occur where it would be important to apply what we know about the influence of certain foods on the rate of pancreatic secretion. Normally the pancreas secretes 500 cc. of juice in 24 hours. Acids or a carbohydrate diet increase this secretion; alkalies, fats, or a protein diet diminish it. Therefore, if you put a patient on diabetic diet a pancreatic fistula may close of itself or render itself amenable to operative closure.

Again, the formula of the pancreatic secretion changes with the diet. There is lactase in the pancreatic juice of milk fed infants. In adults who do not drink milk the lactase here disappears; but, if a milk diet be resumed, the pancreatic juice of the adult will again contain lactase. Perhaps this fact explains the efficacy of the Dubois diet.

The etiology of acute pancreatitis that begins with hæmorrhage may rest upon the fact that certain substances like bile, bacteria, etc., activate trypsinogen. If then, the inert trypsinogen be converted into active trypsin by such agencies, it may well be that the latter ferment erodes or bores a hole through the tissues and sets up the disease.

The question of an increased or diminished pancreatic secretion is an interesting one. Finney has called attention to the occurrence, in patients who complain of indefinite abdominal symptoms, of a dilated duodenum. It is possible that this distention is due to increased secretion of pancreatic juice. No such relation has, however, been proved, though there are certain things in its favor. More important in symptomatology is a diminished pancreatic secretion. Bramwell was the first to cite a case of infantilism in a boy of 19 years who had not grown in 9 years. During all this period of arrested development the patient had had diarrhœa with bulky stools. Under treatment with pancreatic extract, the symptoms disappeared, only to recur with cessation of the treatment. Bramwell thought this a case of functional achylia pancreatica. Other cases have since been reported. It has been suggested that a good many atrophic nurslings are suffering from this condition.

Many cases of acute pancreatitis are not due to hæmorrhage. They may be due to infection, primary or metastatic; or to activation of the ferment. A true pancreatic apoplexy is often without symptoms; the patients are simply found dead. In some cases there are symptoms. In meeting with cases of acute pancreatitis it is always well to remember two things; first, that the condition is usually a recrudescence of an old pancreatic trouble that has been characterized by gall-stones, or nausea, or vomiting, or pain in the region of the ensiform cartilage; and secondly, that prodromata—slight nausea and vomiting, etc.,—are frequent. The ordinary case of this condition begins with retching and vomiting. It is an agonizing

retching. The vomiting is peculiar: incessant, and affording no relief. In only four of the cases analyzed was neither symptom present. In a few cases there was a bloody vomitus. Fæcal vomiting was comparatively frequent. Constipation is an especially important symptom. The constipation is complete and is due to a paralysis of the bowel wall. This paralysis when it passes away is followed by an uncontrollable diarrhœa. The diarrhœa may also occur early in the trouble on account of severe purging. In cases with fever, while the temperature is up, the leucocytes may rise to from 15,000 to 30,000. Glycosuria is an interesting feature. This seldom occurs in the records. In reality, it is not rare where the urine is examined early. To explain this it is only necessary to recall that Flexner has shown that any injury to the pancreas is followed by a temporary glycosuria that disappears in from 4 to 6 days, although the lesion is severe and lasting. It is supposed that nearly all cases would show glycosuria if the urine were examined early enough. In one group of cases the glycosuria develops slowly after the first week when a permanent glycosuria—a true diabetes—usually ensues. Cases that do not die may terminate in gangrene or abscess. In gangrene there are the same symptoms as in acute pancreatitis, with severe diarrhœa and a high leucocyte count. In abscess it is interesting that the abscess will float free while sugar in the urine is infrequent.

Chronic interstitial pancreatitis is commonly due to infections ascending up the ducts. There are no recognizable symptoms. It may be extreme without diabetes, for, as Opie has shown, the islands may be preserved. Atrophy of the pancreas may follow occlusion of the ducts by stones. In some cases there is glycosuria; in many, there is no glycosuria. In many the stools are normal although no juice reaches the intestine and the patient may show no gastric symptoms. In explanation of this latter condition several theories have been advanced; one, that there is an accessory pancreas; another, that there is a vicarious action of the intestinal wall; or again, that what was an external secretion may become an internal secretion. These factors may or may not be so but it is of interest to note that many cases have neither glycosuria nor intestinal features.

A question of interest is why fatty stools are so infrequent in pancreatic disease. The main factor in fatty stools seems to be the condition of the bowel wall. The wall may be no longer able to absorb the fat. In 1832 Bright showed that if you measure carefully the ingestion as well as the output of fat, there are some patients who void more fat than they take in. Perhaps here the fat is no longer used in the body but is eliminated like sugar in glycosuria. In most of these cases you have disease of the bowel wall or of the lymphatics of the bowel wall as in tabes mesenterica.

Discussion.

Dr. Finney.—The question of acute pancreatitis has many interesting points, especially in private practice. In the vast majority of cases the picture is one that at first suggests intestinal obstruction. I can remember 5 cases that I at first diagnosed acute intestinal obstruction. The thing that personally attracts my attention is the tremendous depression of the patient which is out of all proportion to the other symptoms. This is also accompanied by marked cyanosis.

In 2 cases of gangrene of the pancreas I have removed apparently the whole of the pancreas. Both cases are well to-day and are enjoying apparently excellent health.

The question of cancer of the pancreas is extremely interesting. The diagnosis is hardly ever made until operation. What impresses one is the absence of clinical symptoms; the patients begin to go down hill and that is all. There may be, too, slight distress that is referred to the gall-bladder and stomach. In these cases I have been able to do nothing except in those that are associated with intense jaundice.

NOTES ON NEW BOOKS.

Rabies; Its Place Amongst Germ-Diseases, and its Origin in the Animal Kingdom. By David Sime, M. D. (*Cambridge, Eng.: University Press, 1903.*)

"On the basis of these wide researches the following work has been grounded: It is a study of rabies in a threefold direction, its causation in the individual organism; its place amongst germ-diseases with the end of bacterial agency in the animal economy; and, lastly, its origin in the animal kingdom. The treatment of the subject is from a series of standpoints which, in view, are far-ranging through the realm of bacterial life and activity, and which are perhaps not the least important features of the work. Thus in the causation of the disease, the sensory rather than the motor nerve-roots of the cerebro-spinal axis are viewed as the specific nidus of the rabies-microbe, the pathogenic irritation of which is the prime lesion of the malady and underlying all the lesions. The rabies-microbe itself is described as of the simplest to the most complex structure. Far from being always simple and amorphous, it is viewed as in reality multiform, the quantity in the cerebro-spinal axis, and how it is organized, constituting the determining factor of every form of rabies. The paralytic element is taken as much the most important in canine-rabies itself, or in that of even the most attenuating division of the animal kingdom. In like manner the rabies of the sympathetic system is viewed as by far the most serious form of the disease, constituting the rabies characteristic of the intensifying division of the animal kingdom. It is taken as the sole factor of paralytic-rabies with its implication of the secreting system and of every infective form of the malady or of any paralytic element even in canine madness itself. In the consideration of the place of rabies amongst germ-diseases, the malady is treated and expounded as essentially a preventive rather than a prophylactic disease, these being described as the two great orders of the entire realm of germ-disease. Moreover, the particular tissue which forms the exclusive germinating ground of the prophylactic order, on the one hand, and likewise of the preventive orders, centric and peripheral, on the other hand, and as the formative factor of the order, is carefully examined. The very special prophylaxis of the prophylactic type of germ-disease and the general immunity of the preventive type are discussed and explained in detail, and as indicating how far the specific germinating tissue of the

particular order of protection induces the protection. On the other hand, the end of bacterial agency in the germinating tissues of the living economy is also carefully examined, and its vast importance in the origin and establishment of secreting-organs and as a factor of evolution itself. The following study of rabies is largely a revelation of this growth, or of the development of the pathological into the physiological. Again, in the consideration of the origin of rabies in the animal kingdom, the canine source of every form of the malady which presents itself is gravely doubted; and the instability and fading, final character of canine-rabies, as that of the entire attenuating division is demonstrated. The malady is viewed as, primarily, a germ-disease of the intensifying rather than of the attenuating division of the animal kingdom; and the universally excellent results which follow the use of the dog muzzle are accounted for and explained. These are problems of very profound practical not less than of theoretical interest, which are worthy of consideration in spite of their novelty; and the following work is a study of rabies in this triple cycle of relationship."

It would be impossible except at great length to review this work based as it is on the new problems stated in the quotation taken from the preface. Dr. Sime, it should be said, looks with profound respect on all the work done by Pasteur to elucidate this disease, and the author's treatment of the subject, although a novel one, is based on the discoveries of Pasteur. A work with so much original thought as Dr. Sime's, must be read to be understood—it cannot be condensed into a few short sentences by the reviewer, who advises students of this disease to read this volume. Dr. Sime may be right in his theories, but even if wrong, any reader will be stimulated who is willing to study them closely.

R. N.

The Treatment of Disease in Children. By G. A. SUTHERLAND, M. D., F. R. C. P., etc. Cloth. 311 pages. Price, $1.50. (*London: Henry Frowde and Hodder & Stoughton. Oxford University Press, New York, 1907*).

This little book has been written to help the general practitioner and especially the one just starting in practice. It is necessarily lacking in many details owing to the size of the book but in the main it gives the principles of treatment clearly and the methods of treatment advocated are in accordance with the most approved opinions of the day. The space devoted to the various topics is not always perfectly balanced, for example a disease of great rarity, congenital pyloric stenosis, has eight pages whilst the all important subject of diet is disposed of in seventeen. It is unusually difficult, however, to maintain a true sense of proportion in writing a small book upon such a large subject and on the whole, the author has done remarkably well. His ideas upon the subject of infant feeding are essentially English and the use of the percentage method of feeding is not discussed. He gives directions for the syphonage of pleural effusions which he prefers to aspiration. The book closes with a number of prescriptions selected from the Pharmacopoeia of the Paddington Green Children's Hospital.

A Text-Book of Physiological Chemistry. For Students of Medicine and Physicians. By CHARLES E. SIMON, M. D., Professor of Clinical Pathology in the Baltimore Medical College. New (3d) edition. 8vo. $3.25. (*Philadelphia and New York: Lea Brothers & Co., 1907.*)

This text-book is undoubtedly one of the best of its kind. The author, who is well known to medical students and physicians through his admirable text-book on clinical microscopy, presents the subject in a clear and easy way. The book is up to date. One will find in it information about the latest discoveries in protein chemistry, as well as on ferments, hormones, and many other important topics. The methods of qualitative and quantitative determinations of chemical substances important to physiology are well selected and the accuracy of each of them discussed shortly. The relation of the different chemical compounds to pathology is briefly stated. In concluding we think that the book can be recommended to the medical student as well as to the general practitioner.

A History of Nursing. By M. ADELAIDE NUTTING, R. N., Superintendent of Nurses, the Johns Hopkins Hospital, etc., and LAVINIA L. DOCK, R. N., Member of the Nurses' Settlement, New York, etc. In Two Volumes. Illustrated. (*New York and London: G. P. Putnam's Sons, The Knickerbocker Press, 1907.*)

In this excellent history the growth of "Nursing," or the care of the sick is presented for the first time in a complete form. Miss Nutting and Miss Dock have traced this branch of medicine from its earliest sources, to the present day, and have compiled in these two volumes a great deal of information which was only to be found in rare pamphlets and books in foreign languages, as well as in English. Their research work is to be praised, for it seems probable that nothing of value has escaped them. They have succeeded in finding records of nursing which long antedate the birth of Christ, in India, Egypt, and Greece, and have followed its story through Italy, Germany, France, Spain, England, and America. They have collected such a vast amount of information on the subject that they have had some difficulty in handling it, and this is the only essential defect to be found in this history, which will remain for a long time to come the standard work on the subject. The defect is not a serious one, and could easily be altered in a second edition—the work would be improved by some rearrangement of the chapters, and condensation. If this cannot be done, then the authors should write a brief history so that nurses and others may have the pleasure of owning an accurate history of their own profession; since this history is unfortunately beyond the means of many of them. It is impossible to distinguish accurately in the earlier times between nursing and the practice of medicine, so that in this history interesting accounts of medical practice occur frequently. The illustrations have been well chosen and are a revelation of conditions in hospitals which need no text to illuminate the horrors which existed in them. Nursing has often been practiced as a separate profession from medicine—that is there have been bodies of nurses who worked quite independently of hospitals and doctors, but the best nursing has developed in the last twenty-five years with the close union of training schools for nurses with hospitals, and the instruction of the nurses by the attending staffs. The greatest change that has come in "Nursing," however, is the practically complete elimination of the religious element which so long controlled and governed it, not alone in Europe but in Canada as well. Women no longer take up nursing from a religious impulse, but as an avocation and a means to earn a livelihood. The change is doubtless an advance in most respects but much admiration and very high respect is due to the "Sisters," who with an unparalleled waste of effort and strength have devoted their lives to the succor of the poor in a self-sacrificing way which no modern-trained nurse ever approaches. The present system has not yet reached its full development, and will probably go through many more changes before it is really well shaped, but while waiting for its final and highest development we may be well content with the stage it has reached in the past few years, which is in great part due to Miss Nutting. Miss Dock's name is also well known to all those who interest themselves in nursing problems, and there are no other women in this country who could have written such an accurate and at the same time interesting and entertaining account of Nursing.

It may be added for the information of those not acquainted with the latest developments in the life history of nurses that all nurses now graduated from the training schools have to pass special examinations to be permitted to practice their calling in any state and before they are permitted to attach the letters R. N. (registered nurse) to their names. R. N.

The Climatic Treatment of Children. By FREDERICK L. WACHENHEIM, M. D. (*New York: Rebman Company, 1907.*)

This little treatise should prove of particular value as a reference book to the practitioner. It covers more ground than its title indicates, for before taking up the climatic treatment of several groups of diseases, there is a brief but satisfactory review of the factors determining the nature of climate, such as temperature, humidity, cloudiness, rainfall, winds, atmospheric pressure, etc. Then follow two exceedingly valuable chapters, one on the climatology of temperate North America, and the other on that of various health resorts all over the civilized world. The facts adduced concerning the climate of the many regions mentioned are drawn directly from official records when possible, and are presented in a judicial manner and offer to the physician the data for the making of an intelligent choice as to the best available region for his patient.

Proceeding to the climatic management of the normal child and of its various constitutional and visceral diseases, the author has definite suggestions as to the proper kind of climate and the localities near and remote where atmospheric conditions desired are to be had. The experience at the many health resorts in Europe which have been much further developed than in America is freely drawn upon. Some repetition in this portion of the book is apparently necessary, as the climatic treatment of many affections is not dissimilar.

Withal the great value of pure fresh air and general rules of hygiene, irrespective of climate is sanely emphasized throughout the work. The author's opposition to the so-called "hardening" of children is to be approved of, as well as the general statement repeatedly made, that a rigorous or extremely cold climate is seldom desirable for young children, who thrive to best advantage in such places in which they can spend the greatest number of hours out of doors.

An earnest plea is made for the establishment of many more sanitaria in certain localities similar to those which have proved of such great service in Europe. The author's views on the utter futility and often harmfulness to young children of day excursions during the summer, as well as his plea that the stay of children in the various fresh air institutions should be determined by the condition of the patient, are noticed with great satisfaction.

The book is published with a number of maps, a short bibliography and a carefully arranged index by which the climate of any locality and that one suggested for a particular condition is readily indicated. J. H. M. K., JR.

A Treatise on Plague. By W. J. SIMPSON, M. D., Aberd., F. R. C. P Lond., etc. (*Cambridge, Eng.: University Press, 1905.*)

This work which appeared two years ago has but just come to the reviewer who regrets that this important treatise is not better known to the medical profession. There is much in the book which would interest also the general reader. There are but few, except specialists in various lines who really have made a study of this disease, which from a sociological point of view is one of large importance. In this country undue excitement, and unmeasurable fear is aroused in the public by announcements from time to time of the appearance of a few sporadic cases. There is little reason to believe that plague will ever gain a real foothold in this country. But in India where the disease is pandemic, and exists all the time its ravages are far worse than those of tuberculosis, and its control is a question of vital significance to the British Empire. Dr. Simpson has devided his book into four parts: Part one, in three chapters, covers the history and distribution of the plague; part two, in eight chapters, is given over to the epidemiology of plague; part three, with five chapters, discusses plague in the individual; and part four, also with five chapters, considers measures for prevention and suppression of plague. There is also a valuable appendix which gives an account of the provisions adopted by the International Sanitary Convention of Paris, in 1893, to keep plague out of Europe. The volume is further furnished with maps, charts, and illustrations; and is an attractive example of the work of the University Press in bookmaking. "To all those who are actively interested in plague and its prevention, the author dedicates this work," and "to all those" it is warmly recommended. R. N.

Diseases of the Ear. By HUNTER TOD, M. A., M. B. (Cantab.), F. R. C. S. (Eng.), Aural Surgeon to the London Hospital and Lecturer in Aural Surgery at the London Hospital Medical College. One of the "Oxford Medical Publication" series, published by Henry Frowde, and Hodder & Stoughton, London, 1907. Price, $1.50. (*New York: Oxford University Press.*)

This is the most satisfactory manual of otology that has appeared in recent years. It is concise, practical and "up to date," giving the undergraduate medical student just about what he needs and providing even the specialist with a hasty review of modern otology. While compact, it is very complete and not only is every aural topic set forth, but, it is done with such clearness and evident good sense that little more can be wished for. It is really a pleasure to read the book.

I commend it most heartily not only to the students but to all those interested in any subject of otology who want to get at the important facts with the least reading or delay. Questions of treatment upon which differences of opinion may honestly arise are here mentioned as debatable but the author's opinion set forth with a brief convincing argument.

The chapters relating to disease of the middle ear are, naturally, the most interesting and important; the necessity for prompt, early treatment to save life and hearing is well set out and the indications for operative treatment clearly given.

The illustrations are few and of little value; that and a few minor faults may readily be forgiven, however, in view of the general excellence of the book. H. O. R.

International Clinics. Vol. IV. Seventeenth Series. 1907. (*Philadelphia and London: J. B. Lippincott Company.*)

This volume contains numerous papers on treatment, medicine, surgery, gynæcology, etc., a few illustrated, as in the preceeding volumes of this publication, written by Americans and foreigners. The names of almost all the contributors are well known to the profession, and the success of these "Clinics" is due to the interesting papers which appear quarterly. In this volume two articles are worthy of especial note. Dr. Chantemasse's on "Five Years Experience with an Anti-typhoid Serum," and Dr. Calmette's on "The Ophthalmo-Reaction to Tuberculin." In this country Professor Chantemasse's success in treating typhoid is not as well known as it should be, nor has his treatment been studied here or elsewhere as it deserves to be. Dr. Calmette's work is well known to those who can read French, and this paper will greatly help those who cannot, to understand his new work, which may prove to be of great assistance, as a test for tuberculosis. It is very much to be regretted that this volume is defaced by advertisements which the publishers should not have used. It is unpleasant to find these in a volume which is otherwise to be praised, and it is to be hoped that the future volumes will contain no such

advertisements, which detract from its respectability. This is a matter on which it is hard to speak too strongly, and it is surprising that this firm should lower its reputation in this manner. R. N.

The Elements of the Science of Nutrition. By GRAHAM LUSK, M. D. (*Philadelphia: W. B. Saunders & Company, 1907.*)

In the preface of this valuable work, the author states that his aim is to review the scientific substratum upon which rests the knowledge of nutrition both in health and disease. Furthermore, he hopes that the widespread interest in the subject of nutrition may cause his work to be of value to both the student of dietetics and the clinical physician.

In reviewing this work an attempt will be made to give only a brief idea of the subject matter contained in the three broad heads into which it may conveniently be divided: the dietetic, pathological, and theoretical sides. The treatment of the dietetic side is clear and simple. The foundations of the subject are elucidated in several interesting chapters, including discussions on "starvation," "the regulation of temperature," "the influence of proteid food," "the specific dynamic action of foodstuffs," "the influence of ingestion of fat," "the influence of mechanical work on metabolism," and "a normal diet." There is a wealth of information here, but only a few of the more important truths can be presented. For example, in dealing with the body regulations of heat, the author shows us that two sets of factors are concerned, those of chemical regulations acting by increased heat production, and those of physical regulation, acting by variation in the distribution of the blood and increased evaporation of water. Rubner's law, "that the metabolism depends on the amount of heat loss at the surface, and its variation in accordance with this law is necessary for the maintenance of a constant temperature" is discussed briefly.

The subject of nitrogenous equilibrium is fundamental in a consideration of the science of nutrition, and it is dealt with here in a very helpful way, containing a consideration of the effect of increased quantities of meat upon the gain and loss in body flesh and fat, as well as the respiratory quotient. The evidence that amino bodies resulting from certain proteolytic cleavages may be equivalent in the metabolism to ingested proteid itself is presented. The well-known work of Voit, v. Mehring, and Zunt upon the question of the production of fat from proteid is cited in brief.

Different food stuffs vary of course essentially in their dynamic action, and consequently in their effect on nutrition. Lusk we find sums up the influence of the three broad classes of food stuffs as follows: meat ingestion raises the metabolism most, fat next, and sugar least of all. The rivalry of carbohydrates and fats in the economy of nutrition has been an interesting one. The conclusion set forth in this work is that carbohydrates are the most economical of foodstuffs, both physiologically and financially, being the greatest sparers of protein.

Of what should a normal diet consist? This is a question about which both dietician and physician are concerned. Our author gives the original standard of 118 gm. protein, as laid down by Voit, together with the variations from this as exemplified in the dietaries of Rubner, Seven, Attwater, and Chittenden. Short tables of standard dietaries for a man of 70 kilos, as well as municipal food statistics, and hospital dietaries bring into a brief space much valuable information.

To the medical man the sections dealing with the metabolism of disease are most suggestive, and are prefaced as it were with interesting data bearing upon the food requirements during the period of growth. The energy content of cow's milk as compared with human milk is given concisely, and the relation of the growth of infants to their food suply contains much practical information.

Of the pathological conditions considered, anæmia, exophthalmic goitre, diabetes, fever, and gout form the most important, and only a few of the more salient points will be noted in each. Lusk points out that in anæmia the general oxidation of the body is normally maintained provided the disturbances are not of extreme intensity. In exophthalmic goitre there is an increased metabolism, as in a case cited by Friedreich Müller. A high destruction of fat and proteid is taking place, probably due to the toxic action of the thyroid secretion; while in myxœdema a reduced metabolism has been demonstrated. In the discussion of the metabolism in diabetes, the $\frac{D}{N}$ ratio is brought forcibly to the reader's attention, and urged as a method for the clinical examination of severe cases. It is normally 2.8. When, however, a diabetic is given a meat-fat diet, and the 24-hours urine of the second day collected, the discovery of 3.65 gm. of dextrose to 1 gm. of N signifies a complete intolerance for carbohydrates and probably a quickly fatal outcome. Lusk terms this the fatal ratio.

In the chapter on metabolism in fever are found many striking truths. The extreme loss of body proteid during high fever, and the problem of its prevention and replacement are surely of vital interest to the clinician. The lack of a suitable diet in many fevers, considered from the point of view of energy equivalent, is brought to the reader's attention. How critical nutrition may be in disease, we are reminded of, when we reflect that convalescence in such a disease as pneumonia does not commence with the temperature crisis, but the body proteid crisis, a period of about 4 days after the former, when the body begins to add on new protein.

A splendid review of the metabolism in gout is given. The work of Minkowski is quoted in epitomizing the modern knowledge on this subject and his suggestion that some organic compound may be found which will increase the solubility of uric acid or the oxidation of the same is stimulating to students of this disease.

The final chapter is given to a discussion of the theories of metabolism. The composition of protein, the possibility of amino acids being regenerated into protein are among the suggestive thoughts brought out. That the condition of proteid metabolism may be similar to that of starch metabolism (1, digestive hydrolysis; 2, partial combustion of end products; 3, possible regeneration of the end products into substances similar to the original, but characteristic of the organism, that is glycogen and body proteids) is offered by the author for consideration.

This work is an accurate and logical exposition of the science of nutrition. It is timely and should prove of great value to clinicians. In his preface the author states that if this work promotes interest in the laboratory methods to explain the inner processes in disease, his work will not have been in vain. It is hard to conceive how anyone could read this work and not be impressed by the extreme importance of laboratory study of disease, or fail to carry away some of the enthusism for scientific medicine that the author infuses into his work. The book is to be strongly recommended to all interested in medical progress.

Cosmetic Surgery. The correction of featural imperfections. By CHARLES C. MILLER, M. D. 136 pages. 73 illustrations. $1.50. Published by the Author, 70 State St., Chicago, Ill.

This small octavo treatise with less than a hundred pages of text, and with illustrations of a poor quality can not be recommended. If an operation for cosmetic ends is to be performed, it should only be done by a very skilful surgeon of large experience, for such operations are among the most difficult from the point of view of successfully improving the features. Only a study of the work of the great surgeons who have described these delicate operations will help a young practitioner to overcome their difficulties. R. N.

Essentials of Modern Electro-Therapeutics. By FREDERICK FINCH STRONG, M. D. (*New York: Rebman Company, 1908.*)

Dr. Strong has tried in this work to furnish the medical profession with an "elementary text-book on the scientific therapeutic use of electricity and radiant energy," but has unfortunately failed. In a sense it is elementary, but it is hardly intelligible. It is absolutely impossible to describe "physiology from an electric standpoint" in six pages so as to be either useful or comprehensible. Although "electrons" might be considered "elements," they are surely not bodies which can be successfully treated in an elementary style. There are better books on electro-therapeutics—which are "Up to Date," and if not "simple" perhaps "simple" enough and surely "reliable" in spite of our author's views on the subject, and his style is really so bad, overladen as it is with capitals, that it is to be hoped the book will not fall into the hands of many students. R. N.

BOOKS RECEIVED.

A Manual of Clinical Diagnosis. By Means of Microscopic and Chemical Methods. By Charles E. Simon, B. A., M. D. Sixth edition, thoroughly revised. Illustrated with 177 engravings and 24 plates in colors. 1907. 8vo. 682 pages. Lea Brothers and Company, Philadelphia and New York.

Oxford Medical Publications. A Manual of Venereal Diseases. By Officers of the Royal Army Medical Corps. Introduction by Sir Alfred Keogh, K. C. B., Lieut.-Colonel C. H. Melville, R. A. M. C. Colonel Leishman, R. A. M. C. Major C. E. Pollock, R. A. M. C. 1907. 12mo. 282 pages. Henry Frowde, London. Hodder and Stoughton, London.

A Clinical Atlas. Variations of the Bones of the Hands and Feet. By Thomas Dwight, M. D., LL. D., 1907. 8vo. x + 24 pages. 36 plates. J. B. Lippincott Company, Philadelphia and London.

The Correction of Featural Imperfections. By Charles C. Miller, M. D. 1907. 16mo. 134 pages. Published by the Author, 70 State Street, Chicago.

A Text-Book of Minor Surgery. By Edward Milton Foote, A. M., M. D. Illustrated by four hundred and seven engravings from original drawings and photographs. 1908. 8vo. 752 pages. D. Appleton and Company, New York and London.

A Treatise on Plague. Dealing with the Historical, Epidemiological, Clinical, Therapeutic, and Preventive Aspects of the Disease. By W. J. Simpson, M. D., Aberd., F. R. C. P., Lond., D. P. H. Camb. 1905. 4to. 466 pages. University Press, Cambridge.

A Laboratory Manual of Invertebrate Zoölogy. By Gilman A. Drew, Ph. D. With the Aid of Members of the Zoölogical Staff of Instructors of the Marine Biological Laboratory. Woods Holl, Mass. 1907. 12mo. 201 pages. W. B. Saunders Company, Philadelphia and London.

International Clinics. A Quarterly of Illustrated Clinical Lectures and Especially Prepared Original Articles. Edited by W. T. Longcope, M. D. Volume IV. Seventeenth Series, 1907. 8vo. 308 pages. J. B. Lippincott Company, Philadelphia and London.

A History of Nursing. The Evolution of Nursing Systems from the Earliest Times to the Foundation of the First English and American Training Schools for Nurses. By M. Adelaide Nutting, R. N., and Lavinia L. Dock, R. N. In Two Volumes. Illustrated. 1907. 8vo. G. P. Putnam's Sons, New York and London.

Australasian Medical Congress. (Formerly the Intercolonial Medical Congress of Australasia.) Transactions of the seventh session held at Adelaide, September, 1905. Published under the direction of the Editorial Committee, South Australia. 1907. 8vo. 510 pages. C. E. Bristow, Adelaide.

A Very Young Ovum in Situ. By Prof. G. Leopold. Comprising the fourth volume of the "Arbeiten aus der Frauen Klinik in Dresden." With sixteen lithographic plates. Authorized English translation by W. H. Vogt, M. D. 1907. 4to. 69 pages. C. V. Mosby Co., St. Louis.

Light and X-Ray Treatment of Skin Diseases. By Malcolm Morris, F. R. C. S., Ed., and S. Ernest Dore, M. D., Cantab. With twelve plates. 1907. 12mo. 172 pages. W. T. Keener and Co., Chicago.

Diagnostics of the Diseases of Children. By Le Grand Kerr, M. D. Fully illustrated. 1907. 8vo. 542 pages. W. B. Saunders Company, Philadelphia and London.

Diseases of the Genito-Urinary Organs and the Kidney. By Robert Holmes Greene, A. M., M. D., and Harlow Brooks, M. D. With 292 illustrations. 1907. 8vo. 536 pages. W. B. Saunders Company, Philadelphia and London.

The Pancreas: Its Surgery and Pathology. By A. W. Mayo Robson, D. Sc. (Leeds), F. R. C. S. (Eng.) and P. J. Cammidge, M. B. (Lond.), D. P. H. (Camb.). Illustrated. 1907. 8vo. 546 pages. W. B. Saunders Company, Philadelphia and London.

Principles and Practice of Modern Otology. By John F. Barnhill, M. D., and Ernest de Wolfe Wales, B. S., M. D. With 305 original illustrations, many in colors. 1907. 8vo. 575 pages. W. B. Saunders Company, Philadelphia and London.

Atlas and Text-Book of Human Anatomy. By Dr. Johannes Sobotta. Edited, with additions, by J. Playfair McMurrich, A. M., Ph. D. Volume III. Vascular System, Lymphatic System, Nervous System, and Sense Organs. With 297 illustrations, mostly in colors. 1907. 8vo. 342 pages. W. B. Saunders Company, Philadelphia and London.

An Introduction to the Study of the Infant's Stool. By Paul Selter, M. D. The translation of a monograph entitled "Die Verwertung der Fæcesuntersuchung für die Diagnose und Therapie der Sauglings Darmkatarrh, nach Biedert." Translated by Herbert M. Rien, B. L., M. D. 1907. 4to. 28 pages. The Detroit Medical Journal Company, Detroit, Mich.

A Text-Book of Physiological Chemistry. By Charles E. Simon, B. A., M. D. Third edition, thoroughly revised. 1907. 8vo. 490 pages. Lea Brothers and Company, Philadelphia and New York.

Essentials of Modern Electro-Therapeutics. An Elementary Text-Book on the Scientific Therapeutic Use of Electricity and Radiant Energy. By Frederick Finch Strong, M. D. 1908. 8vo. 112 pages. Rebman Company, New York.

Rabies; Its Place Amongst Germ-Diseases, and its Origin in the Animal Kingdom. By David Sime, M. D. 1903. 8vo. 290 pages. University Press, Cambridge.

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